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THE QUEENSLAND JOURNAL OF AGRICULTURAL SCIENCE

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JUNE, 1956.

GROWTH STUDIES OF BEEF CATTLE IN QUEENSLAND.

By G. I. ALEXANDER, B.V.Sc. (Senior Husbandry Officer, Cattle Husbandry Branch) and R. D. CHESTER, B.V.Sc. (formerly Officer in Charge, Cattle Husbandry Branch.)

SUMMARY.

A progress report on growth rate studies of various breeds and crosses of beef cattle at several centres is presented.

The data indicate that the seasonal variation common to all centres may be controlled to some extent by the use of winter-growing pastures and forage crops and by using cattle of tropical origin in breeding programmes.

I. INTRODUCTION.

Growth rate studies of beef cattle have been carried out on a small scale by the Queensland Department of Agriculture and Stock over a number of years.

Mulhearn (see Chester 1952) conducted growth rate studies with beef steers from 1936 to 1939 at Charters Towers and Tully. The Tully investigations were directed at studying the effect of transferring young growing stock from the drier inland for quick fattening on introduced grasses on the coastal wet belt of North Queensland. Subsequently, investigations into the coastal fattening of beef cattle were continued at the Bureau of Tropical Agriculture (South Johnstone) and at the Ayr Regional Experiment Station. Progress reports on the investigations at both centres have appeared in the Annual Report of the Queensland Department of Agriculture and Stock for the years 1939–40 to 1954–55 (South Johnstone) and 1946–47 to 1954–55 (Ayr).

Since the initiation of investigations into the growth rate of beef cattle in the southern States of Australia in 1950, a number of weighing centres have been established in Queensland in order to obtain a complete picture of the growth rate of beef cattle under subtropical and tropical conditions. None of these trials have been carried out for a sufficient period to permit conclusive data to be presented. Nevertheless, there is enough information available to show the trend which can be expected.

This review of the present knowledge of growth rates in Queensland beef cattle has been undertaken to supplement the comprehensive unpublished information compiled by Dr. M. C. Franklin on growth rates of cattle in other States.

II. DESCRIPTION OF INVESTIGATION CENTRES AND THEIR RELATION TO THE SURROUNDING BEEF CATTLE DISTRICTS.

Data have been collected from eight centres, the location of which is shown in Fig. 1.

Fig. 1.

Sketch Map Showing the Distribution of the Weighing Centres.

(1) "Texas Station", Texas.

"Texas Station" is a property of about 8,000 acres situated on the Dumaresq River near the New South Wales border. It has an average annual rainfall of about 25 in., and both the summer and winter components are fairly reliable.

Approximately 2,500 acres of the property consist of a freely drained clay loam, representative of the fertile alluvial frontages to the Dumaresq River.

A large area is suitable for lucerne growing without irrigation and a systematic scheme of conservation of fodder in the form of lucerne hay and silage is practised. Improved pastures have also been sown and the paddock on which the cattle under observation were fattened carried a mixture of Wimmera ryegrass, phalaris and lucerne.

The property lies in an area free from cattle tick (*Boophilus microplus*).

An Aberdeen-Angus stud has been maintained on the property for many years, and large numbers of bullocks of high quality are fattened annually.

A large proportion of the Shires of Waggamba and Inglewood, which together have a cattle population of 120,000, has a similar climate to "Texas Station," and some of the region has a similar potential for crop production and pasture improvement.

(2) "Meridan Plains", Landsborough.

This property consists largely of river frontage to the Mooloolah River and comprises 3,000 acres. The area receives a high annual rainfall (about 65 in.), which occurs mainly during the summer.

Much of the property is subject to flooding and is badly drained, the soils below 20 in. being of mottled yellow clay. Most of the soils are grey-brown sandy loams to grey loams of alluvial origin. These run back into low ridges of light-grey sandy loam.

Apparently the river flats originally carried an open stand of *Eucalyptus tereticornis* (blue gum) and some patches of *Melaleuca leucadendra* (tea-tree), with fringing forest along the large streams. The fringing forest extended over portion of the flat to form scrub.

The greater part of the flats carries a mixture of *Carex appressa* (a sedge), *Paspalum dilatatum* (paspalum), *Axonopus affinis* (narrow-leaf mat grass), and *A. compressus* (broad-leaf mat grass), with some *Trifolium repens* (white clover).

The stocking rate on the property is quite high, that on the better flats being in the vicinity of a beast to the acre. However, at least during part of the year the cattle probably suffer from mineral deficiencies, notably of phosphorus and copper, and from time to time they are heavily parasitised by both internal parasites and cattle tick.

A Poll Hereford stud is established on the property.

The property is situated outside the main beef cattle areas, but the growth rates are indicative of those to be expected over most of the near-coastal belt from Maryborough south to the border, the beef cattle population of which is about 30,000.

(3) "Brian Pastures", Gayndah.

"Brian Pastures" is a grazing property of 5,300 acres owned by the Australian Meat Board and operated by the Queensland Department of Agriculture and Stock as a pasture research station. It is situated on the west bank of Barambah Creek, about 10 miles from Gayndah. The average annual rainfall of the district is about 29 in., and some winter rains occur.

The property is covered with ridges of varying slopes, and there are broken areas of levee bank and flood plain regions along the creeks. The soil types are closely related to the parent rocks, basalt areas giving rise to brown and red-brown soils of heavy texture and granitic and acid basaltic rocks yielding sandy soils. A grey clay soil occurs on the creek alluvial flat.

The vegetation was originally an open eucalypt forest. On the alluvial flats the forest is a pure or nearly pure stand of *Eucalyptus tereticornis* (blue gum), with *E. populnea* (poplar box) on the gentler slopes. On the remainder of the property the main trees are *E. dichromophloia* (bloodwood), *E. melanophloia* (silver-leaved ironbark) and *E. crebra* (narrow-leaved ironbark), with occasional trees of *E. tessellaris* (Moreton Bay ash).

The pasture grasses are now mainly *Heteropogon contortus* (black spear grass), with a number of blue grasses (species of *Dichanthium* and *Bothriochloa*).

The property is tick-infested, but tick control is satisfactory.

The breeding herd of approximately 250 cows of Hereford and Poll Hereford origin is being mated to Poll Hereford bulls.

The property is in the centre of the large beef cattle raising district of the Burnett, whch has a cattle population of approximately 200,000.

(4) "Eulogie Park", Dululu.

"Eulogie Park" is situated in the Dawson Valley about 50 miles south-west of Rockhampton. The average annual rainfall is about 30 in., of which some 25 in. normally fall in the summer.

There is a diversity of soil types on the property. Those on which the recorded stock were run range from deep red scrub soils of the softwood association to the shallow dark-brown brigalow-wilga soils.

Much of the original softwood and brigalow vegetation has been bulldozed and cleared and the area oversown to Rhodes and green panic grasses. Grasses naturally found in the brigalow area have persisted to some extent.

A Poll Hereford stud is maintained on the property and a large number of bullocks of high quality are fattened each year.

"Eulogie Park" has been developed more than most other beef cattle properties in the area, but the growth rates of the cattle are indicative of those which could be achieved in an area with a beef cattle population of 200,000.

(5) "Belbroughton", Kunwarara.

"Belbroughton" is situated about 50 miles north of Rockhampton and has an average annual rainfall of 35 in. The rainfall is chiefly monsoonal, with storm rains falling in December-March and only scattered unreliable falls during winter-spring. Summer maximum temperatures are usually between 85 and 95 deg. F., and fairly cold winters are experienced.

The soils range from heavy brown to black clays derived from serpentine rocks.

Now extensively ringbarked, the original trees were mainly *Eucalyptus crebra* (narrow-leafed ironbark). The grasses are mainly blue grasses (species of *Bothriochloa* and *Dichanthium*), with small patches of *Heteropogon contortus* (black spear grass).

The breeding herd of approximately 250 head of grade Hereford cows has been mated .to approximately equal numbers of Hereford and ¼ Zebu, ¾ Hereford bulls.

The growth rates of the cattle are indicative of those of cattle over most of the beef cattle country of the Shires of Livingstone and Broadsound, with a beef cattle population of 250,000.

(6) "Mungalla", Ingham.

This property is situated within five miles of Ingham in an area with an 80 in. rainfall.

The bulk of the property consists of alluvial flats, with grey-brown sandy loams running back into sandy ridges.

The main pasture species on the property are *Cynodon dactylon* (couch grass), *Paspalidium distans* (a brigalow grass), *Paspalum orbiculare* (a swamp paspalum) and *Setaria pallidifusca* (a pigeon grass). *Brachiaria mutica* (para grass) and *Panicum maximum* var. *typica* (guinea grass) have been established over much of the property and in some areas comprise half the sward.

The cattle on the property are mainly Zebu-British breed crosses with varying percentages of Zebu blood.

While the beef cattle population of the area is rather small, being less than 20,000, it is capable of considerable expansion with further introduction of para and guinea grasses.

(7) Bureau of Tropical Agriculture, South Johnstone.

The Bureau of Tropical Agriculture of the Queensland Department of Agriculture and Stock is situated in the wet tropical coastal belt.

The average annual rainfall recorded at the Bureau is 120 in., and the precipitation varies from 80 to 180 in. per annum. Approximately 75 per cent. of the rainfall is received in the period January-July, and by far the heaviest falls are recorded in February and March. From August to November conditions are relatively dry, and variable rains occur in December. The maximum temperature rarely exceeds 90 deg. F. in summer and may fall as low as 40 deg. F. in winter. The humidity, however, is generally high throughout the year.

The Bureau is situated in an area with brown clay-loam alluvial soils of high permeability.

The pastures established on the station are in 2-acre paddocks which are grazed rotationally; they vary in composition but contain *Brachiaria mutica* (para grass), *Panicum maximum* var. *coloratum* (purple top Guinea grass), *Pueraria phaseoloides* (puero) and *Calopogonium mucunoides* (calopo). The stocking rate of the pastures is of the order of 1 beast to 1·25 acres.

The beef cattle population of the district is quite low, being less than 5,000. There are indications that, with widespread use of the pasture mixtures developed at the Bureau, 30,000 head of cattle could be fattened annually on country considered suitable for this type of development.

(8) "Wairuna", Mt. Garnet.

"Wairuna" is situated on the coastal tableland of North Queensland about 50 miles west of Cardwell and 70 miles south-east of Mt. Garnet. The property lies roughly half-way between the Great Dividing Range to the west and the Cardwell Range to the east. It is about 1,800 ft. above sea level.

The average annual rainfall of 28 in. is mainly of summer incidence. Summer temperatures are high, reaching several degrees over 100 deg. F., while frosts are common in the winter.

The country consists almost exclusively of granitic soils with a light sandy surface overlying clay. There are some silt deposits on the flooded edges of the lagoons which support a good body of couch grass.

The main trees are *Eucalyptus crebra* (narrow-leafed ironbark), *E. populnea* (poplar gum), and *E. dichromopholoia* (bloodwood), with *Casuarina* sp. (bull-oak) in the gullies. The most common grasses are *Themeda australis*

(kangaroo grass), *Heteropogon contortus* (black spear grass) and species of *Eragrostis* (love grasses). A blue grass (*Bothriochloa decipiens* var. *cloncurriensis*) is also found in the ringbarked areas.

Crossbred British cattle have been run on this property for many years and a nucleus of American Brahman cattle has been used to supply a proportion of the bulls in the breeding herd.

The property is situated in the centre of a large beef cattle breeding area, with a beef cattle population in the vicinity of 250,000 head. The growth rates observed at "Wairuna" would be indicative of those over the whole of the district.

III. EXPERIMENTAL RESULTS.

This review has been prepared in order that a broad appreciation of beef cattle performance under Queensland pastoral conditions could be readily obtained. Some of the relevant information has already been published.

The presentation of the data is based on that used by Dr. M. C. Franklin in his unpublished reports on the situation in the southern States of Australia, and the histograms and graphs have been prepared in the same manner so that easy comparison may be made.

The data from all weighing centres are presented graphically, and the mean daily weight changes between successive weighings, together with the monthly rainfall, as a series of histograms.

(1) "Texas Station", Texas.

Data on the bodyweight of 32 Aberdeen-Angus steers are summarised in Figs. 2 and 3. They were collected over the period Aug. 19, 1954 to May 20, 1955.

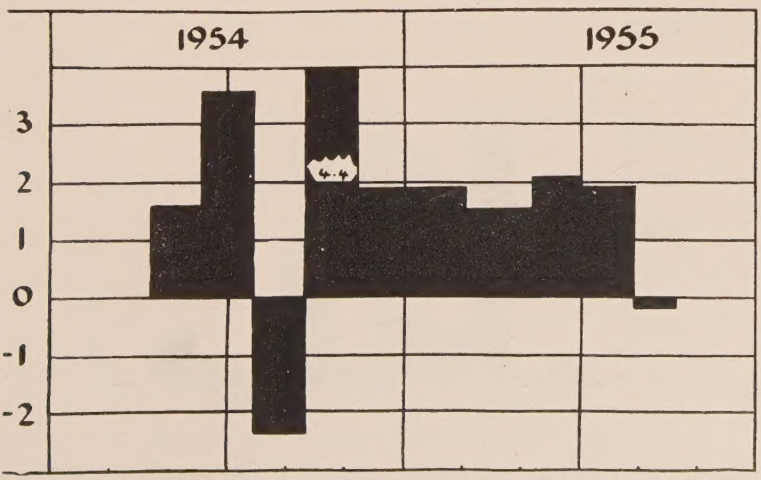

Fig. 2.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Texas Station", Texas. 32 Aberdeen-Angus bullocks (born 1952) weighed from 19.8.54 to 20.5.55.

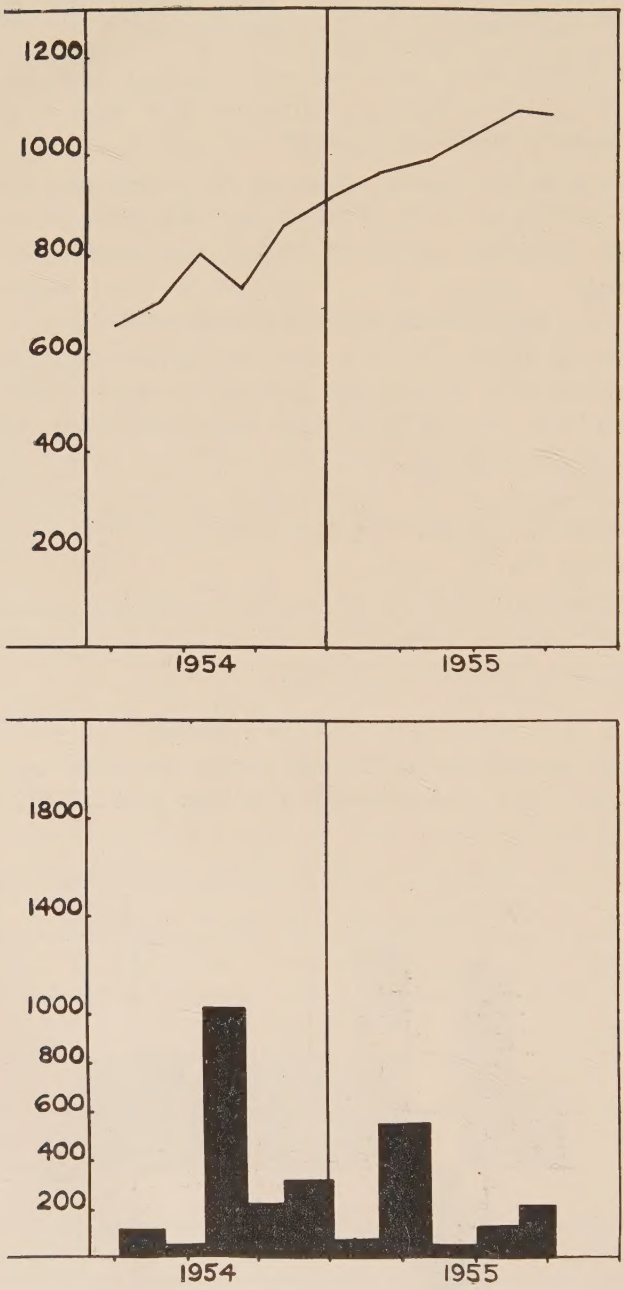

Fig. 3.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Texas Station", Texas. 32 Aberdeen-Angus bullocks (born 1952) weighed from 19.8.54 to 20.5.55.

The stock showed a steady weight gain, except in October, when the paddocks were flooded. The weight gains recorded are in excess of 1·5 lb. daily. This is quite noteworthy, especially for August and September; it may be assumed that these gains are associated with the use of winter pastures.

(2) "Meridan Plains", Landsborough.

The growth studies of three groups of Poll Hereford heifers indicate a steady growth rate during the last three or four months of each year and the first four months of the next year. However, during the period May to August the stock either lost weight or barely maintained it.

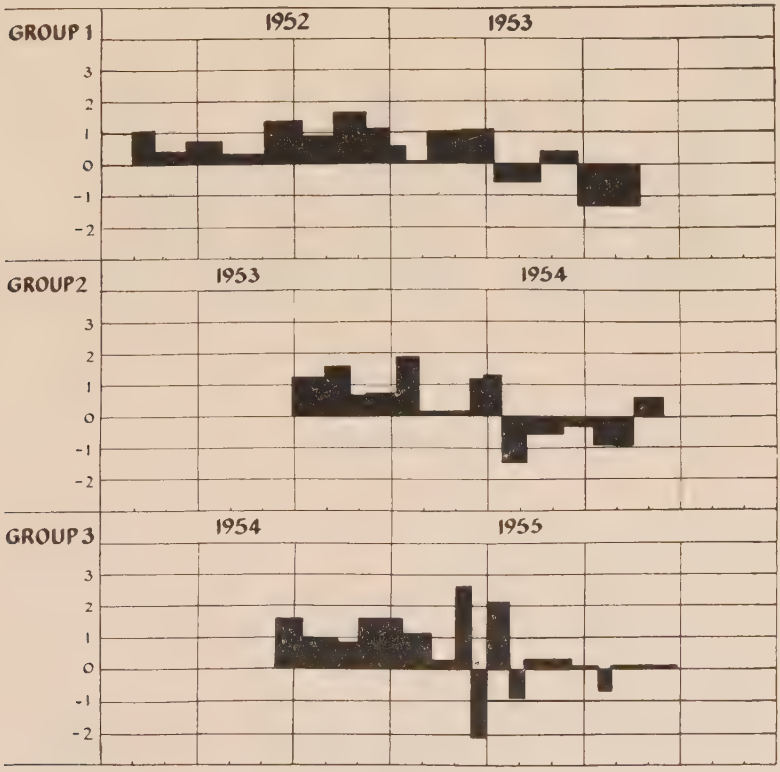

Fig. 4.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Meridan Plains", Landsborough.

Group 1—14 Hereford heifers (born 1951).

Group 2—12 Hereford heifers (born 1952-53).

Group 3—13 Hereford heifers (born 1953-54).

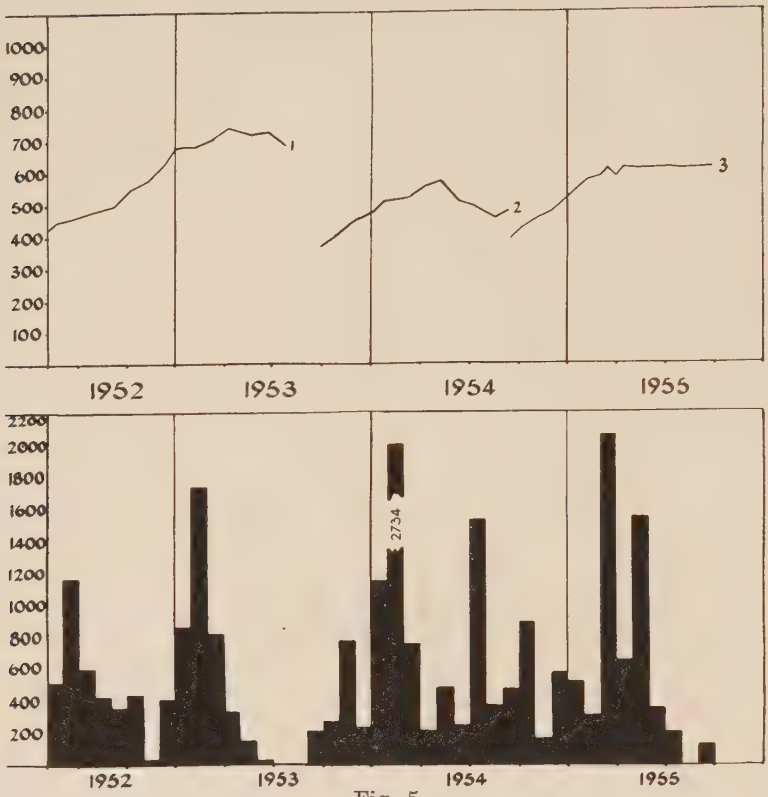

Fig. 5.

Graph Showing Liveweight Changes (in Pounds), and Histogram showing Monthly Rainfall (in Points), at "Meridan Plains", Landsborough.

Group 1—14 Hereford heifers (born 1951).
Group 2—12 Hereford heifers (born 1952-53).
Group 3—13 Hereford heifers (born 1953-54).

The weight gains recorded during the growing season are of the order of 0·5 lb. to 1·0 lb. daily, which is comparable with those at "Mungalla" but is somewhat less than those at the Bureau of Tropical Agriculture, the other high-rainfall centre.

(3) "Brian Pastures", Gayndah.

Weighing of all the cattle on the property, which are of Hereford and Poll Hereford composition, has been conducted regularly since February, 1954. The data presented relate to the growth rate of steers and replacement heifers run on natural pastures. Steers and heifers weaned in 1953 and 1954 and steers weaned in 1955 are included. The first two growth curves are for 25 steers weaned in 1953 and 20 heifers weaned at the same time. The steers represent the lightest of the animals at weaning, while the heifers were the best grown ones. Consequently, the steers are lighter than the heifers at all weighings.

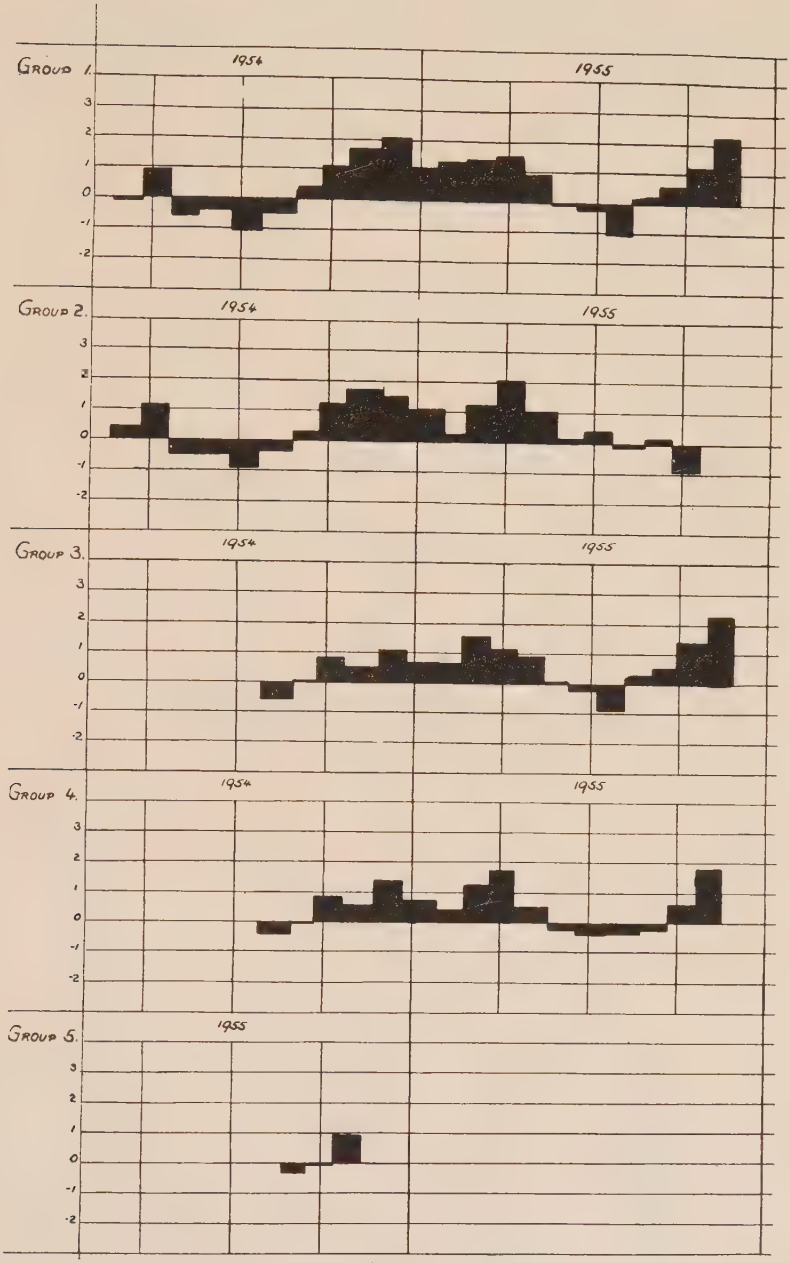

Fig. 6.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Brian Pastures", Gayndah.

Group 1—25 Hereford steers (1953 weaners).
Group 2—20 Hereford steers (1953 weaners).
Group 3—38 Hereford steers (1954 weaners).
Group 4—21 Hereford heifers (1954 weaners).
Group 5—66 Hereford steers (1955 weaners).

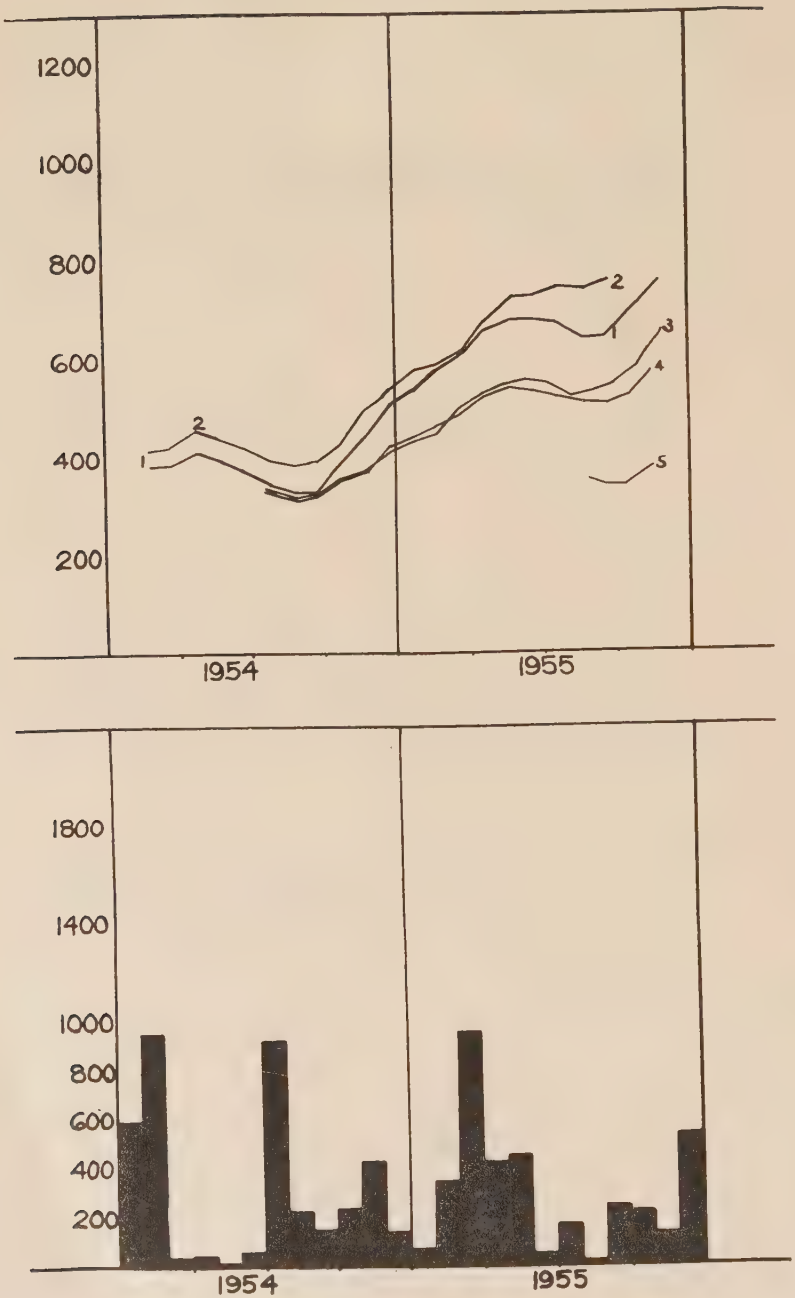

Fig. 7.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Brian Pastures", Gayndah.

Group 1—25 Hereford steers (1953 weaners).
Group 2—20 Hereford heifers (1953 weaners).
Group 3—38 Hereford steers (1954 weaners).
Group 4—21 Hereford heifers (1954 weaners).
Group 5—66 Hereford steers (1955 weaners).

It is interesting to note that the 38 1954 steers and the 21 1954 heifers are more nearly comparable in weight and that they were only slightly lighter than the steers which were one year older at the end of the 1954 winter. In contrast, these 1954 cattle were fully 200 lb. heavier than the 66 1955 steers at the end of the 1955 winter. The 1954 winter was better than average, but that of 1955 was noticeably mild throughout and did not cause any marked weight loss (Fig. 7).

(4) "Eulogie Park", Dululu.

One group of 20 weaner Poll Hereford steers has been weighed regularly since Aug. 25, 1953. Grazing on the natural pastures available on the property, they have shown a seasonal weight fluctuation, with winter weight losses.

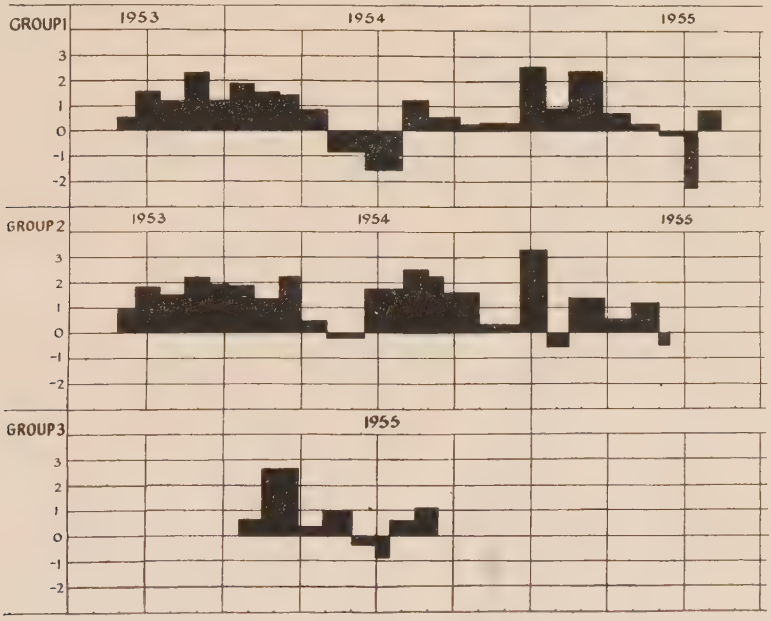

Fig. 8.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Eulogie Park", Dululu.

Group 1—20 Poll Hereford steers (1953 weaners).
Group 2—25 Poll Hereford steers (1954 weaners).
Group 3—10 Poll Hereford steers (1953 weaners) run on crop from May 1954 to Nov. 1954.

Another group of 25 Poll Hereford steers weaned in October 1954 have been weighed regularly since Jan. 17, 1955, and have exhibited a comparable weight fluctuation.

Another group of 10 Poll Hereford steers were weighed regularly while on pasture from Aug. 25, 1953, until Apr. 30, 1954, when they were turned on to an oat crop with a mob of bullocks. Initially they lost weight on the oats; this may perhaps be attributed to a settling-down period. Subsequently

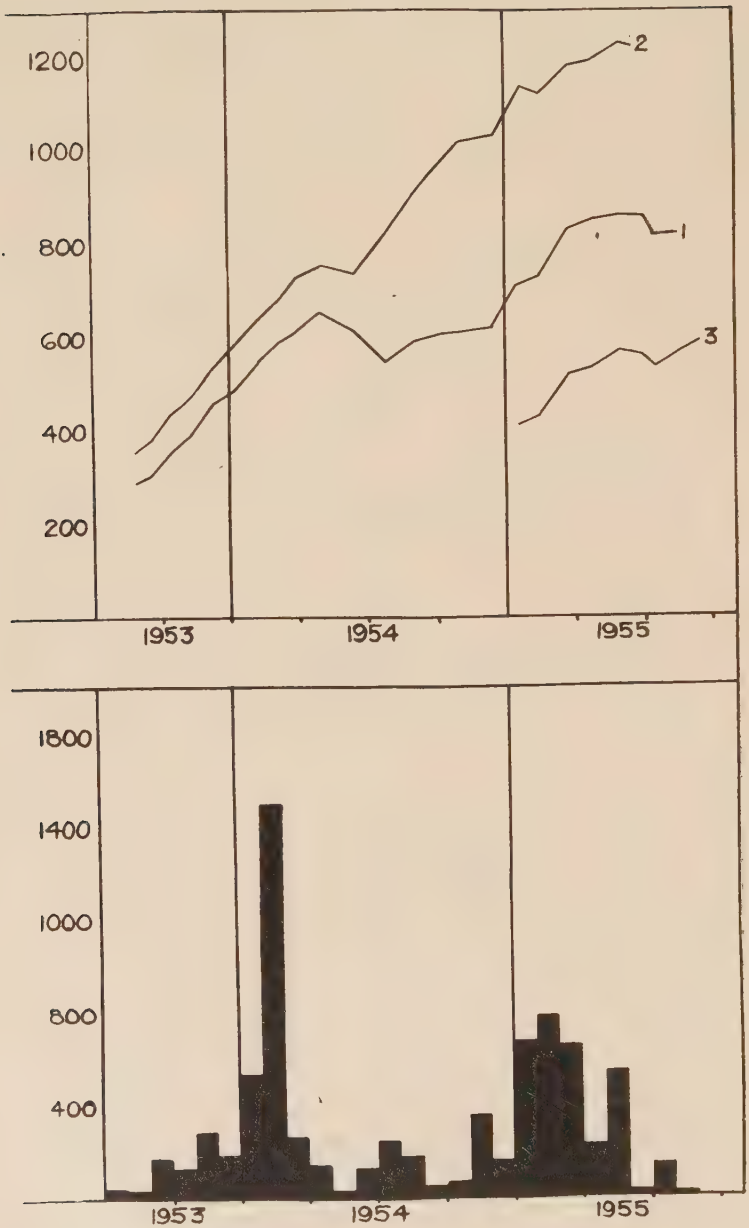

Fig. 9.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Eulogie Park," Dululu.

Group 1—20 Poll Hereford steers (1953 weaners).
Group 2—25 Poll Hereford steers (1954 weaners).
Group 3—10 Poll Hereford steers (1953 weaners) run on crop from Apr. 30, 1954.

they showed gains in the vicinity of 2 lb. daily until November, when they were once again relying on natural pastures. They were kept on natural pastures until turned off on June 13, 1955. Their winter weight gains indicate the improvement which can be expected from winter cropping. The group of steers of comparable age with which they were running initially will not be turned off until June 1956.

(5) "Belbroughton", Kunwarara.

The initial groups of Hereford and Zebu-Hereford weaner steers have been weighed regularly since Nov. 12, 1953.

A second trial was commenced on Nov. 4, 1954, with another two groups of cattle.

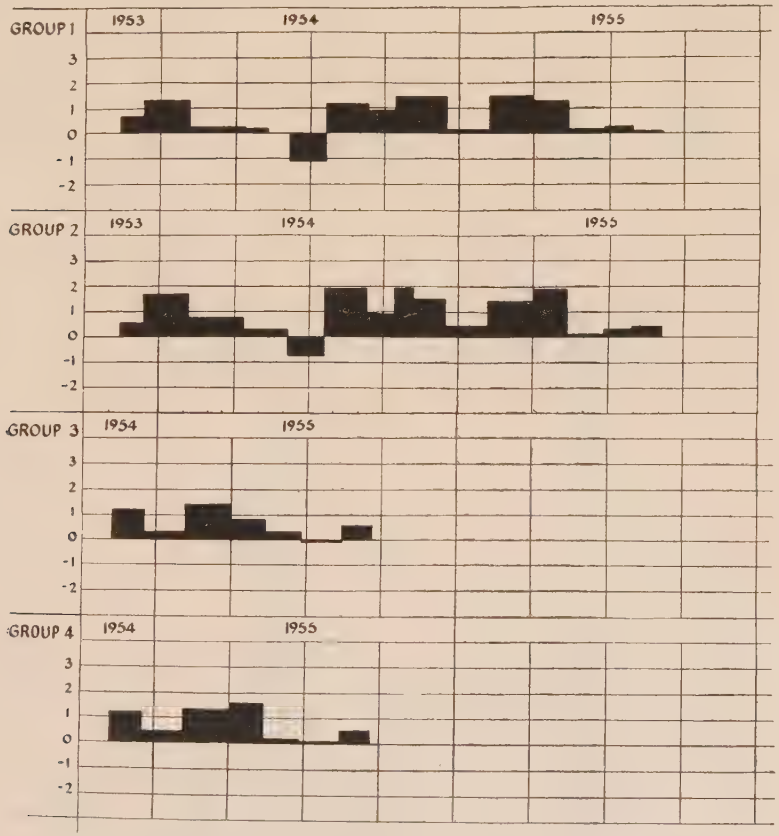

Fig. 10.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Belbroughton", Kunwarara.

Group 1—20 Hereford steers.
Group 2—14 Zebu-Hereford steers.
Group 3—17 Hereford steers.
Group 4—21 Zebu-Hereford steers.

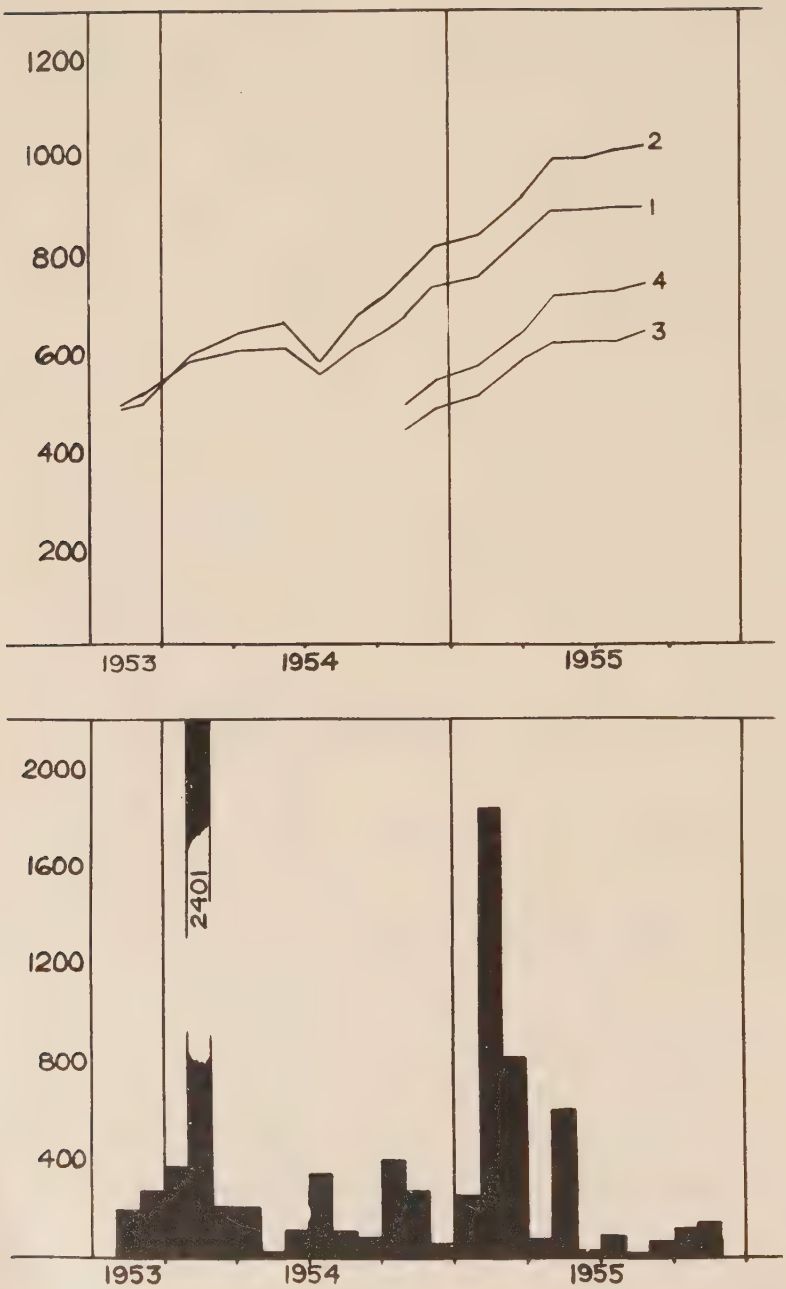

Fig. 11.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Belbroughton," Kunwarara.

Group 1—20 Hereford steers.
Group 2—14 Zebu-Hereford steers.
Group 3—17 Hereford steers.
Group 4—21 Zebu-Hereford steers.

The growth rates of the Hereford and Zebu-Hereford steers followed the same seasonal pattern, but the Zebu-Hereford group was observed consistently to gain more and lose less weight than the Hereford steers. This, allied to their greater weaning weight, has produced an ever-widening margin between the weights at the same age. During the period of maximum growth in the late spring and summer, both groups recorded weight gains in excess of those at "Mungalla" and "Meridan Plains."

(6) "Mungalla", Ingham.

On this property two groups of cattle with varying proportions of Zebu and British breed blood were weighed. One consisted of 25 replacement heifers and the other of 10 steers of comparable age. The growth data obtained gave indications of a similar trend to those obtained at other centres, but the trial was discontinued before the trend was clearly shown.

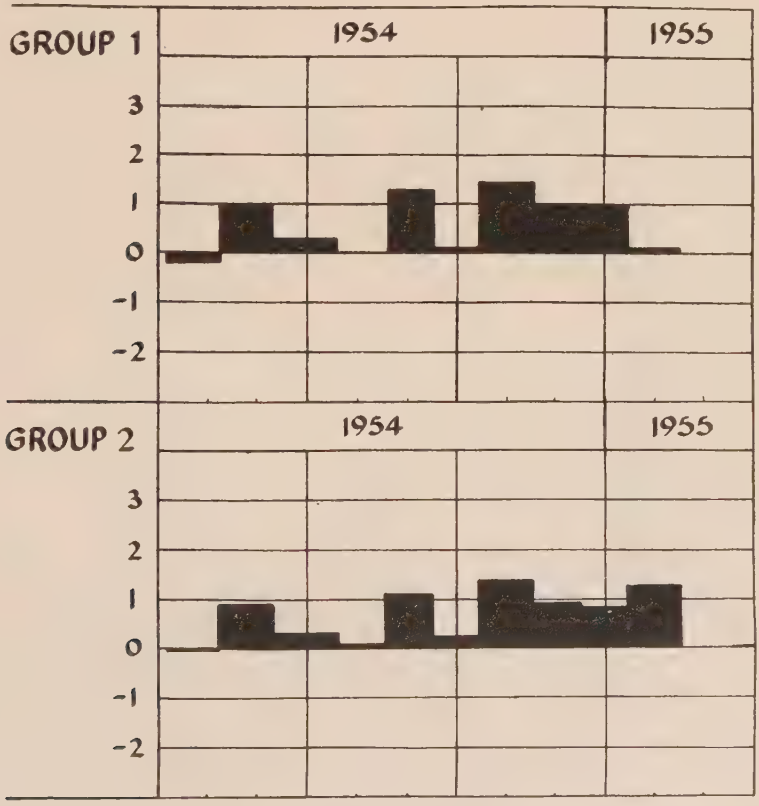

Fig. 12.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Mungalla," Ingham.

Group 1—10 Zebu cross steers.
Group 2—25 Zebu cross heifers.

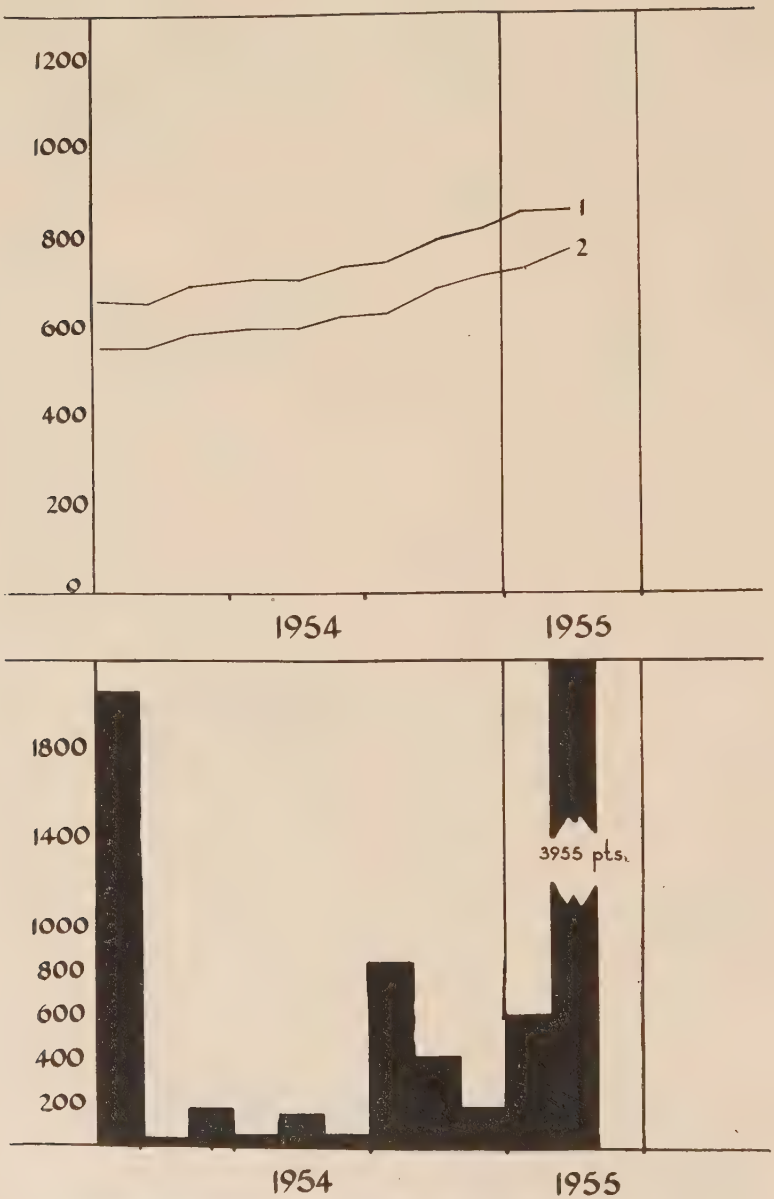

Fig. 13.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Mungalla," Ingham.

Group 1—10 Zebu cross steers.

Group 2—25 Zebu cross heifers.

(7) Bureau of Tropical Agriculture, South Johnstone.

The weight gains from the Zebu cross and British breed cattle, which were rotationally grazed on balanced pastures of high quality, are comparatively high, only tapering off during the spring when the bullocks were "finished." The seasonal weight gains so evident at most of the other weighing centres are not so marked under the conditions at the Bureau. The fattening of beef cattle on these pastures would appear to be quite a sound procedure, as there is little variation in the rate of fattening in the various years. The Zebu cross and British breed bullocks showed rather similar rates of fattening, with the Zebu cross somewhat heavier.

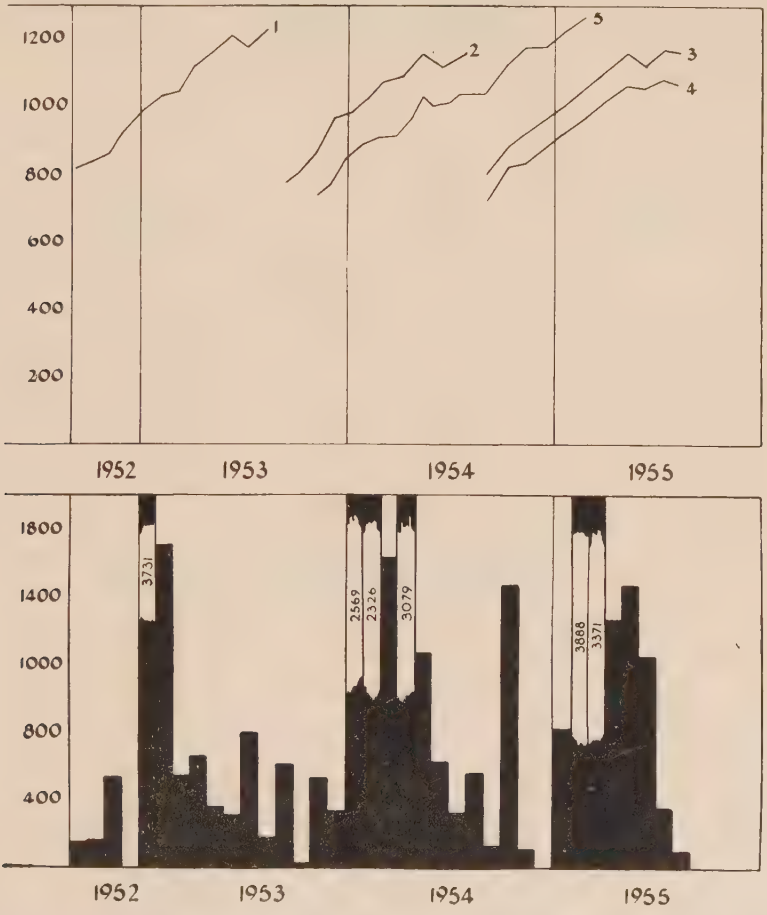

Fig. 14.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at Bureau of Tropical Agriculture, South Johnstone.

Group 1—16 Shorthorn bullocks (2½-3 years).
Group 2—16 Hereford bullocks (2½-3 years).
Group 3— 6 Zebu cross bullocks (2½-3 years).
Group 4— 6 Hereford bullocks (2½-3 years).
Group 5— 7 Australian Illawarra Shorthorn bullocks (born Jan. 1952).

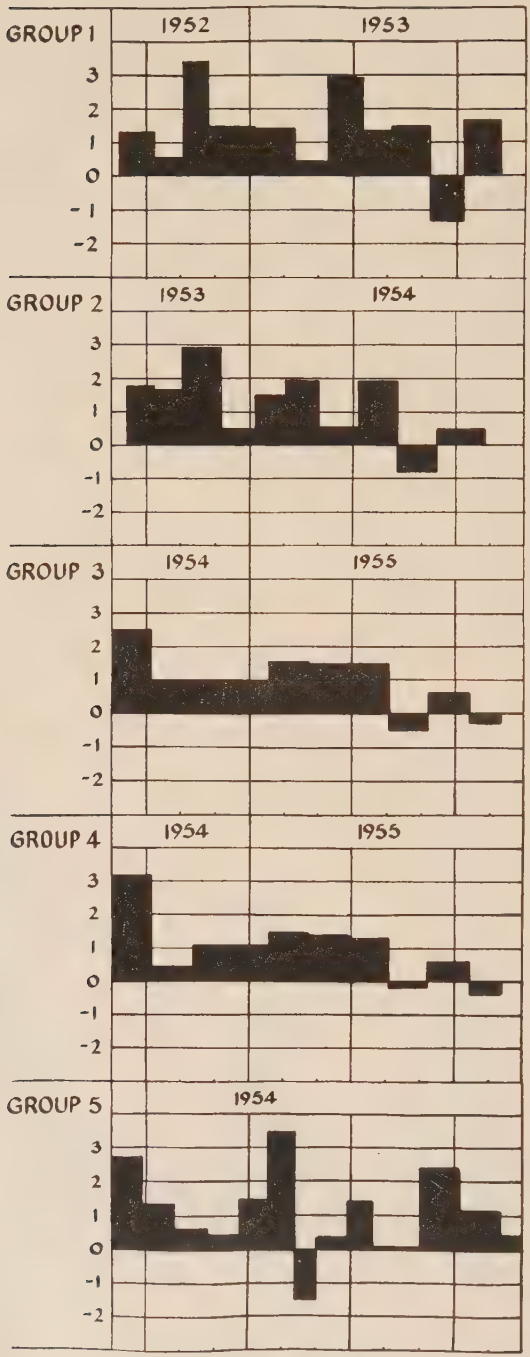

Fig. 15.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at Bureau of Tropical Agriculture, South Johnstone.

Group 1—16 Shorthorn bullocks.
Group 2—16 Hereford bullocks.
Group 3— 6 Zebu-cross bullocks.
Group 4— 6 Hereford bullocks.
Group 5— 7 Australian Illawarra Shorthorn bullocks.

(8) "Wairuna", Mt. Garnet.

One trial comparing the growth rates of Zebu cross and British breed weaner steers with 25 in each group commenced in November, 1952, and was completed on May 9, 1955. The growth pattern in each group was similar, with the British cattle gaining 607 lb. and the Zebu cross 698 lb. during the period of the trial. The seasonal weight fluctuations were more severe than those observed at other centres. Rapid weight gains of a high order were recorded during the summer and early autumn, followed by losses in late winter and spring.

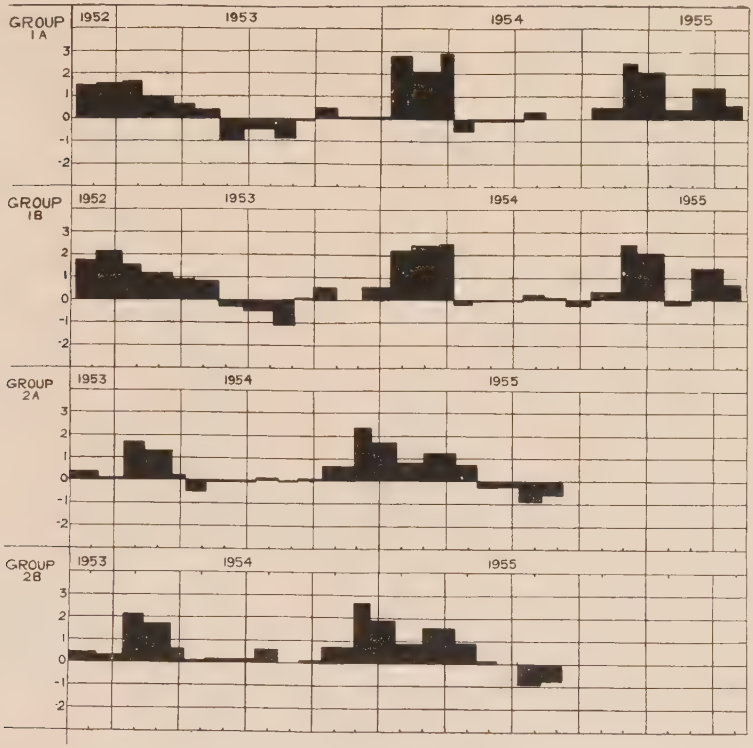

Fig. 16.

Histogram Showing the Mean Daily Weight Change (in Pounds) Between Weighings at "Wairuna," Mt. Garnet.

Group 1A—25 British crossbred bullocks (weaned 1952).
Group 1B—25 Zebu cross bullocks (weaned 1952).
Group 2A—20 British crossbred bullocks (weaned 1953).
Group 2B—25 Zebu cross bullocks (weaned 1953).

A second trial involving 25 Zebu cross and 20 British breed weaner steers was commenced on Oct. 31, 1953. These cattle showed similar weight trends to those in the first trial, with an ever-widening gap between the weights of the Zebu cross and the British breed bullocks.

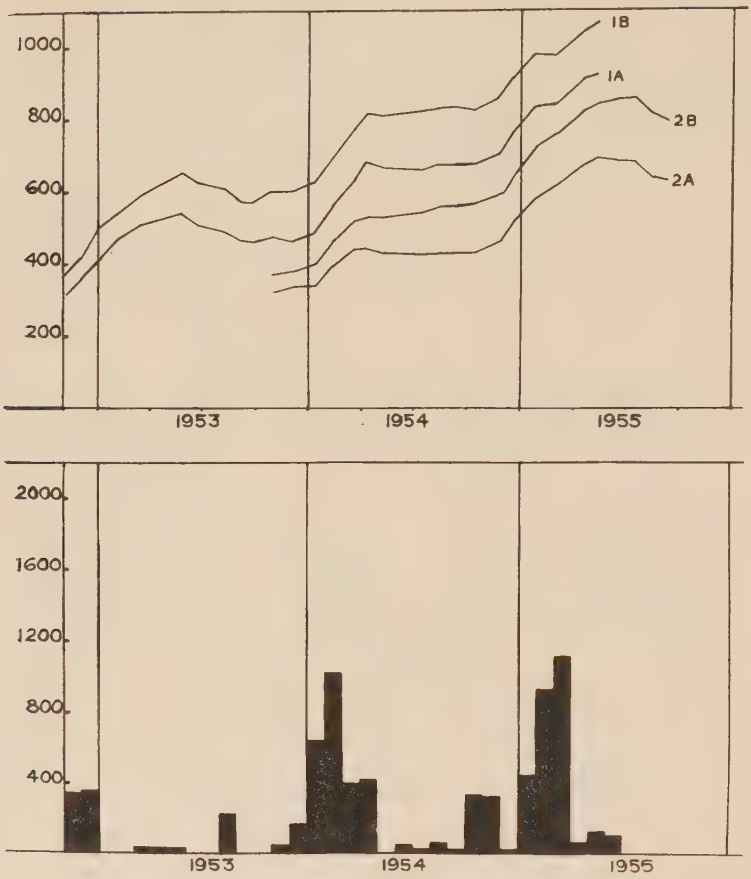

Fig. 17.

Graph Showing Liveweight Changes (in Pounds), and Histogram Showing Monthly Rainfall (in Points), at "Wairuna," Mt. Garnet.

Group 1A—25 British crossbred bullocks (weaned 1952).

Group 1B—25 Zebu cross bullocks (weaned 1952).

Group 2A—20 British crossbred bullocks (weaned 1953).

Group 2B—25 Zebu cross bullocks (weaned 1953).

IV. DISCUSSION.

(1) Seasonal Pattern of Growth.

In considering the growth rates of cattle at "Meridan Plains," "Brian Pastures," "Eulogie Park," "Belbroughton" and "Wairuna," which are centres from which a sufficient volume of information to permit comparisons has been obtained, it is apparent that the seasonal fluctuation in weight is highest at the more northerly stations.

Two of the stations ("Brian Pastures" and "Wairuna") have a rather similar pasture type, one consisting predominantly of *Heteropogon contortus,* a summer-growing species which is not capable of much winter growth; the period of pasture growth is shorter at "Wairuna" than at "Brian Pastures."

"Belbroughton", with pastures predominantly of blue grass, is intermediate between "Wairuna" and "Brian Pastures" in length of growing season. It more closely resembles that at "Brian Pastures," but this may be due as much to the more nutritious pasture species as to a longer period of pasture growth.

"Eulogie Park," with predominantly introduced grasses, has a similar growing period to "Belbroughton."

"Meridan Plains," which is in an area of high and reasonably well distributed rainfall, should present a much better growth pattern than any of the other centres, but the predominance of a pasture of low nutritive value (composed of *Axonopus affinis*) limits the growth rate.

A study of the seasonal fluctuations in weight shows that the low plane of nutrition during the winter imposes a severe limitation on beef cattle production in Queensland. It has the effect of retarding the even development of the animal and produces an undesirable relationship of muscle, fat and bone. Cattle which suffer these seasonal setbacks are relatively old and heavy before they develop a sufficient fat cover to allow them to be turned off for slaughter.

It is in the northern centres that the adverse seasonal effects are felt to their fullest extent; here bullocks are turned off with a dressed weight of 800 lb., when a dressed weight of 550-650 lb. is preferred. This has an adverse effect on Australia's export trade, as the producer is unable to produce, off grass, a carcase possessing the desirable combination of finish and light weight.

(2) Remedial Measures.

Two remedial measures are available to the producer:—

(*a*) He may improve the feeding of the animal so that it is not subjected to any weight loss or at least its weight loss is minimised.

(*b*) He may develop or obtain cattle which are better able to withstand the rigours of the climate than those he has now.

(a) Improvement of Nutrition.

There are a number of ways whereby the nutrition of the cattle can be improved. It will suffice to record those used in association with our growth studies.

Pasture Improvement.—In areas of reliable winter rainfall, the summer-growing natural pasture may be supplemented by areas sown down to winter-growing species. This was done at "Texas Station." Unfortunately, the growth rate of the bullocks recorded prior to being turned on to the improved pasture here was not recorded, but a study of the growth rate data for natural pastures on other properties shows that cattle almost invariably either lost weight or barely maintained their weight in August, whereas cattle given access to winter-growing pastures gained in the vicinity of 2 lb. daily during the August-September period.

Crop Supplements.—Where there is a reasonable winter rainfall, crops can also be used to minimise winter weight losses. This was illustrated at "Eulogie Park," where steers run on oats from April to November, 1954, showed appreciable weight gains until November, when the crop was eaten out and they had to rely on natural pastures. The stock could have been sold at this time but were carried on by their owner for a specific market.

Judicious use of winter crops can result in the production of marketable fat bullocks from August to November, a period when there is usually a short supply of such cattle. This practice is being developed in some parts of the State.

(b) Improved Types of Cattle.

Much attention has been focussed on the performance of Zebu cattle and their crosses in the Queensland environment. The underlying cause of this interest is that from an ecological and broad climatological viewpoint, Queensland should be stocked with cattle of tropical origin. Wright (1954) considered that tropical coastal Queensland should be stocked with cattle comparable in heat tolerance to those of subtropical coastal areas of North Africa (Fig. 18)—i.e. be capable of tolerating, at moderate humidities, variations in temperature ranging from the temperate to the tropical. These conditions are identical with those in Texas, U.S.A.

Inland from the Queensland coast the climate changes; the range of temperature lies higher and the humidity is markedly lower. Here, Wright considered, the type of stock should, on the basis of climographs,* resemble in climatic tolerance the large purebred Zebus of India and Africa.

Still further inland, the climate is such as to require stock resembling in climatic tolerance the medium-sized purebred Zebu inhabiting the coastal desert tracts of India.

* A climograph is constructed by plotting as a single graph the mean monthly air (dry bulb) temperatures against the mean monthly relative humidities. By this means the combined influence of these two weather criteria for different localities can be studied. Since cattle are affected to a major degree by temperature and humidity, these provide useful guides to the suitability of the environment for any particular class of cattle.

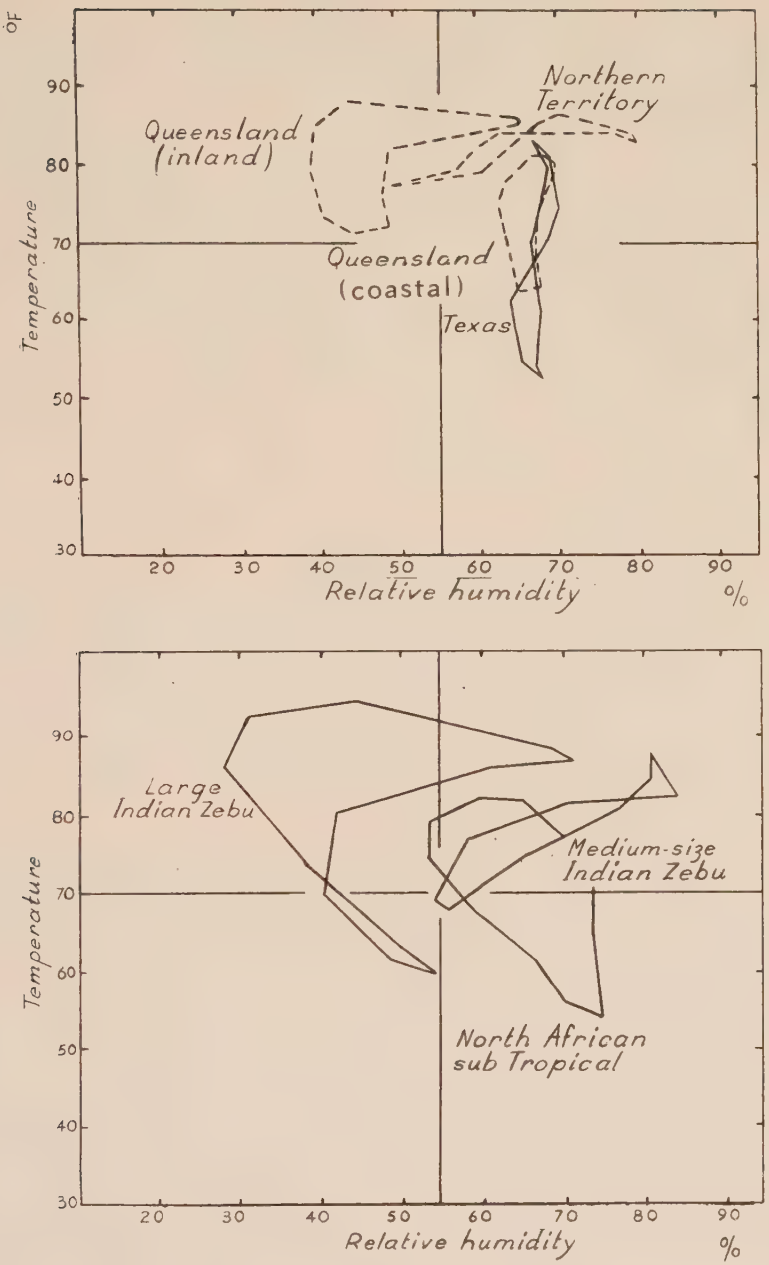

Fig. 18.

Climographs for Various Regions in Which Beef Cattle are Raised. The centres are—Croydon (Queensland inland), Rockhampton (Queensland coastal), Darwin (Northern Territory), San Antonio (Texas, U.S.A.), Delhi (large Indian Zebu), Karachi (medium-sized Indian Zebu), and Cairo (North Africa subtropical).

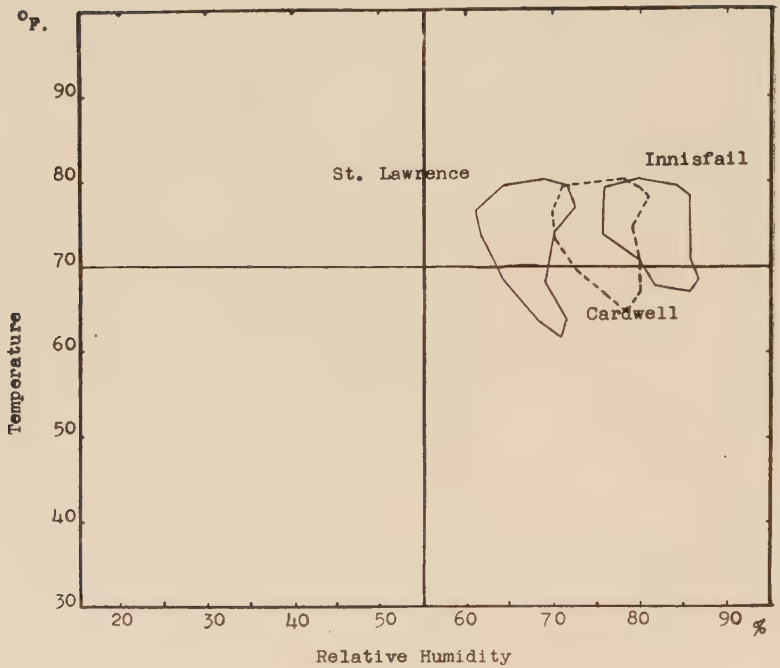

Fig. 19.

Climographs for Recording Stations Near the Tropical Weighing Centres of "Belbroughton" (St. Lawrence), "Mungalla" and "Wairuna" (Cardwell), and Bureau of Tropical Agriculture (Innisfail).

The climographs for the weighing centres in the tropics (Fig. 19) are situated in the top right-hand section of the graph, indicating a hot and humid environment. This is similar to that recorded by Wright for Texas and the North African subtropical area. It is on these data that Wright based his recommendations.

At three of the tropical centres, the growth rate of Zebu-cross cattle has been compared with that of British cattle originating in a temperate climate. These centres are "Wairuna," "Belbroughton" and the Bureau of Tropical Agriculture. The last two come under the general classification of Queensland coastal climate. At all three centres, the data indicate that the Zebu-cross cattle are heavier than British cattle of comparable age. However, they did not gain weight at a markedly higher rate during the summer months, which is the period of climatic stress. There is a slightly greater rate of gain in favour of the Zebu-cross but not sufficient to demonstrate a much greater ability to withstand the stresses imposed by the climate.

One of the causes which may be responsible for this slight difference is altered grazing time. Under the free grazing conditions in Queensland, British cattle seem to have adopted a behaviour pattern by which they can minimise the adverse effects of the climate. Larkin (1954) showed that British cattle

at the Bureau of Tropical Agriculture grazed intensively during the hours of early morning and late evening. Zebu-cross cattle grazed irrespective of the time of day. The grazing time of British cattle was reduced in the summer months but not sufficiently so to reduce growth rate (Fig. 14). The stock at the Bureau were on highly nutritious pasture.

Probably the main reason why there was greater overall growth rate of the Zebu-cross cattle at "Wairuna" and "Belbroughton" was that they did not lose as much weight during the winter period of nutritional stress as did the British breeds. In areas where cattle have to travel greater distances for feed during the summer and where the fodder is less nutritious, the hardiness of the Zebu-cross cattle may show to advantage in the summer months as well as in the winter.

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XANTHORRHOEA HASTILE POISONING OF CATTLE.

By W. T. K. HALL, Senior Veterinary Pathologist, Animal Research Institute, Yeerongpilly.*

SUMMARY.

Four feeding experiments with Xanthorrhoea hastile **(swamp grasstree) were done in an endeavour to produce the condition known as wamps or North Coast disease of cattle.**

The disease was not produced when a 480 lb. heifer was fed 204 lb. of chaffed spikes in 48 days, nor when a 530 lb. steer was fed 305 lb. in 50 days.

Typical symptoms of the field condition were produced when 467 lb. was fed to a 200 lb. heifer in 73 days, and when 470 lb. was fed to a 400 lb. animal in 48 days.

A delayed effect of the plant toxin was observed.

The symptoms are an ataxia in which there is a diagonal progression brought about by swinging of the hindquarters always to the same side. Often urinary incontinence, with the beast in the normal urinating posture, is seen. There is frequently complete recovery, but death may occur from starvation if the animal becomes recumbent and is unable to rise.

I. INTRODUCTION.

As part of a programme of investigations into the apparently non-infectious diseases of cattle grazed on the wallum country of south-eastern Queensland, *Xanthorrhoea hastile* (swamp grasstree) was fed experimentally.

The wallum country was described by Young (1946) as the sandy coastal plain stretching north from the New South Wales border to Rockhampton. It takes its name from wallum (*Banksia serratifolia*), a small tree which is common in the area. The soil types and vegetation have been described by Andrews and Bryan (1955). The soil is generally acid and deficient in most plant nutrients.

On the wallum country there are several conditions in cattle in which an abnormality of gait is a prominent symptom. Two of these—phosphate deficiency and poisoning by a species of *Macrozamia*—have been clearly differentiated. The effects of phosphate deficiency (Theiler 1931, Barnes and Jephcott 1955) and of the ingestion of macrozamia (Edwards 1893, Hall 1954) have been described.

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A conspicuous symptom of phosphate deficiency described by Theiler (1931) is a stiffness of gait. For this reason the disease is known in South Africa as "stiff sickness" or "stifziekte," and in Australia as "pegleg." It is most prevalent in young cows, particularly if lactating. Fractures of the bones may occur, and consequently in Australia the disease is also referred to as "soft bone."

Ingestion of macrozamia by cattle causes a permanent disability of the hind limbs. On movement, the hindquarters sway from one side to the other and affected animals are referred to by farmers as being "rickety."

An additional syndrome has been recognised for many years and is known as "wamps" or "North Coast disease" (Fig. 1).

Fig. 1.

A Cow Naturally Affected by *Xanthorrhoea hastile* Poisoning. The back is curved and the animal is dribbling urine. The appetite is good.

Under the heading "North Coast Disease," the condition was described in the Annual Report of the Queensland Department of Agriculture and Stock for 1919-20 as follows:—

"The first indication was a slight stiffness of movement associated in the majority of cases with incontinence of urine. In other respects the beast appears perfectly healthy, appetite good, eye bright, coat sleek, temperature, respiration, and pulse normal. This motor disturbance gradually increases during the following week or so. By this time a paralysis, involving the large muscles of the back, usually on one side, has become manifest. When standing at rest no disability is noticeable, but on movement, the spinal column, posterior to the withers, is acutely flexed. The tail is also noticeably raised and carried to one side. The beast can no longer move directly forward, progression being of a sideways nature. In a small percentage of cases observed the paralysis appeared to involve the muscles on both sides of the backbone . . . At this stage, when the beast lies down it cannot regain the upright position without assistance."

II. OCCURRENCE AND DISTRIBUTION.

The incidence of the disease is variable and losses are high only in some years.

As well as in the wallum country previously described, "wamps" is seen in an area of so-called wallum north of Townsville (A.A. Seawright, unpublished report, 1953—Queensland Department of Agriculture and Stock Files). The common grasstree in this area was recently determined by the Government Botanist as *Xanthorrhoea* sp. aff. *media* R.Br.

In southern Queensland the disease occurs from October to February. This is during the period of growth of a number of shrubs, among which is the swamp grasstree (*X. hastile*). This grasstree flowers early in its period of regrowth, so flowering plants are present at the time of the year when the disease occurs. Some stock-owners have maintained for many years that the young inflorescence of the swamp grasstree when eaten by cattle caused "wamps."

III. DESCRIPTION OF THE PLANT.

The genus *Xanthorrhoea* is limited to Australia. All species are popularly known as grasstrees. The larger ones with a caudex or trunk several feet high are often known also as black boy. In most species the caudex exudes a considerable amount of resin. The flowers are borne in a spike at the end of a scape. This scape is smooth, reaches several feet in length, and on maturity becomes stiff.

X. hastile has a very short caudex, rising only a few inches above the ground. The inflorescence is four to six feet high when mature. The lower two-thirds is a smooth scape, and the upper third a thicker, rough, flowering spike.

On the area of wallum country outlined in Fig. 2 there were more than 10,000 grasstrees per acre (S. T. Blake 1953, pers. comm.), indicating that this plant constitutes almost the entire cover in certain places.

Fig. 2.

Stand of *Xanthorrhoea hastile* (swamp grasstree). Normally the flower spike is about one-third the length of the scape on which it is borne. The numerous short spikes seen in this photograph are apparently due to grazing when the spikes were young.

As the occurrence of the disease coincided with the growing and flowering period of this plant, and as the spikes are readily eaten by cattle, feeding experiments were done.

IV. FEEDING EXPERIMENTS.

(1) Experiment 1 (1953).

Plant.—Grasstree identified as *X. hastile* was collected from an area where the disease has occurred.

As stock normally eat only the flower head or spike of the plant, this part was chaffed and fed with lucerne. Many of the spikes had mature, semi-dry seeds, and were rather fibrous.

A fresh batch of plant was obtained each week and was fed 3–10 days after collection.

Feeding.—Commencing on Nov. 20, a heifer 480 lb. in weight ate 2½ lb. of plant mixed with 7–8 lb. of lucerne per day for 29 days. The rate was then increased to 7–8 lb. of plant per day with a reduced quantity of lucerne. A total of 204 lb. of grasstree was eaten during 48 days. The animal remained normal throughout.

(2) Experiment 2 (1954).

Plant.—The plant obtained, though less mature than that fed in Experiment 1, was still quite fibrous. Again, only the spike was fed. Mincing was resorted to in the latter part of the experiment to increase the rate of consumption.

Feeding.—Commencing on Oct. 18, a steer 530 lb. in weight was fed for 18 days with chaffed grasstree and a mixture of oaten and lucerne chaff. Only 70 lb. of plant was eaten. For a further 32 days the method of feeding was similar, but the grasstree was first chaffed and then minced in a household food-mincer. Fed this way, a further 235 lb. of grasstree was eaten, making a total of 305 lb. in 50 days. The animal remained normal throughout.

(3) Experiment 3 (1954).

Plant.—As in the two previous experiments, only spikes of *X. hastile* were fed. The degree of maturity of the plant varied. At the beginning of the experiment it consisted mostly of young succulent flower heads, but later the greater part of the material used was the older, fibrous seed-heads. A sample of this latter material contained on a dry matter basis:—

	%
Protein	6·8
Carbohydrates	45·9
Fat	1·2
Fibre	42·7
Ash	3·4
P_2O_5	0·31
CaO	0·26

Feeding.—Feeding of a heifer about 15 months old and weighing 200 lb. was commenced on Oct. 16. During the first 37 days, 117 lb. of grasstree was eaten with 74 lb. of chaff consisting of one-third lucerne and two-thirds oaten. To increase the intake of the more fibrous material it was thereafter minced. During the following 36 days, a further 350 lb. of grasstree was eaten, together with 36 lb. of oaten chaff. The variations in the amount of plant and chaff eaten are set out in Fig. 3. A total of 467 lb. of grasstree flower head was fed in 73 days.

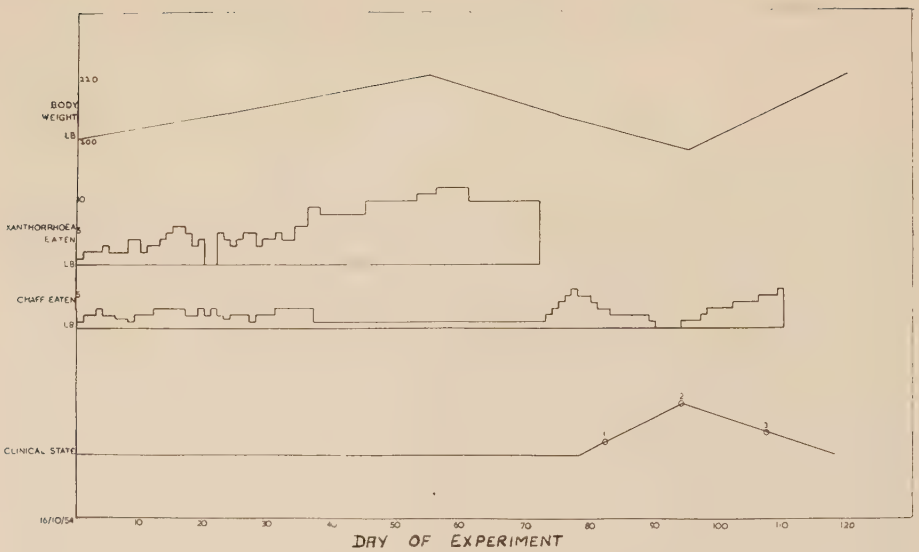

Fig. 3.

Diagram Showing Body Weight, Feed and Clinical State of the Heifer Fed in Experiment 3. The clinical state is shown against a fictitious ordinate. The point 1 is where the first definite symptoms of leg weakness and ataxia, with urination still normal, became evident; at point 2 the beast was down and most severely affected; at point 3 leg weakness was evident as at point 1, but full control of urination had not been regained.

Fig. 4.

Experimental Heifer Fed *Xanthorrhoea hastile*. The back is curved and on movement the animal swings to its left side.

When feeding stopped the beast was normal, but 10 days later definite clinical symptoms of "wamps" were seen. On exercise, weakness of the front legs and swinging of the hindquarters, always to the left side, were obvious. The heifer would step sideways or even turn halfway round in an effort to retain balance (Fig. 4). Fifteen days after experimental feeding was concluded, urinary incontinence was evident, and the urinating posture was frequently assumed (Fig. 5). One week later the beast was recumbent and could be exercised only if helped to its feet and given considerable assistance. The animal was kept alive by attention to bedding, shade, feed and water, and its condition improved in a few days. Recovery was complete after two months.

Fig. 5.
Experimental Heifer Showing the Typical Urinating Posture.

The blood concentrations of vitamin A, carotenoid and phosphate were within normal limits when determined on three occasions during the experiment. They were as follows:—

Day of Experiment.	Vitamin A. (micrograms per 100 ml. plasma).	Carotenoid. (micrograms per 100 ml. plasma).	Inorganic Phosphate. (milligrams per 100 ml. blood).
54	24	112	4·3
74	36	64	5·6
94	23	160	6·0

(4) Experiment 4 (1955).

Plant.—Again only the spikes were fed. They were cut into small pieces with a hand chaff-cutter and mixed with oaten chaff. As in Experiment 3, the degree of maturity varied. Analysis of the plant, which was less mature than that used in the previous experiment, showed on a dry matter basis:—

	Preflowering Stage.	Flowering Stage.
	%	%
Protein	11·1	10·0
Carbohydrate ..	63·7	59·8
Fat	2·2	2·2
Fibre	19·0	23·4
Ash	4·0	4·6
P_2O_5	0·47	0·36
CaO	0·56	0·77

Feeding.—As much *X. hastile* as the animal would eat was fed to an 18-months-old heifer 400 lb. in weight. Commencing on Oct. 20, 470 lb. was eaten in 48 days. During this period the amount of grasstree was gradually increased and the proportion of oaten chaff reduced.

On the 48th day of the experiment, when the feeding of grasstree was stopped, no definite abnormality of gait could be seen. After the 70th day, the heifer was grazed in a small paddock with other cattle. At the beginning of this period there was a slight ataxia, but this was attributed to the previous stalling on concrete. However, five days later the ataxia was apparent and the animal had difficulty in getting to its feet. Typical symptoms were observed after a further four days—that is, one month after the feeding of *X. hastile* had stopped. The symptoms were a swinging of the hindquarters to the left, and lateral flexion of the spinal column to the left side.

The paralysis gradually became more pronounced, and on the 87th day of the experiment, or 39 days after feeding of grasstree was stopped, the animal died. Autopsy showed no macroscopic abnormality except contusion of muscle of the hind limbs and haemorrhages of the fasciae. This is in agreement with the findings in naturally affected animals which succumb.

Sections of liver, kidney, lung, sciatic nerve and femoral nerve were stained with haematoxylin and eosin; the only abnormality detected was oedema of the lungs. Sciatic and femoral nerves treated according to the Marchi technique showed no abnormality.

Blood phosphate, plasma carotenoid and vitamin A figures during the experiment were:—

Day of Experiment.	Vitamin A. (micrograms per 100 ml. plasma).	Carotenoid. (micrograms per 100 ml. plasma).	Inorganic Phosphate. (milligrams per 100 ml. blood).
20	40	550	8·3
40	50·5	205	5·3
58	35·7	87	5·3

V. DISCUSSION.

In the first two experiments the daily intake was not high and the plant was more mature than when normally grazed. The spikes of mature plants contained 6·8 per cent. and the young spikes 11·1 per cent. protein.

The morbidity is usually not high. It seemed, therefore, that the toxicity of the grasstree might be low, and in the third and fourth experiments every effort was made to feed as much of it as possible. Very little other food was allowed, and as a result the beast in the third experiment lost weight. In the fourth experiment there was a loss of weight during the first 10 days, but over the whole experimental period a moderate gain in weight was recorded.

The complete clinical recovery of one of the affected animals is in keeping with the normal course of the disease in natural cases.

A remarkable feature of this disease is that circling or swaying is always to the one side. There would appear to be an impairment of muscular or nervous function, but no explanation of why it should be unilateral can be given.

Urination is frequent and may be practically continuous. Catheterising while urine was dribbling produced only 10 oz. of urine on each of two occasions. The bladder could not be palpated in the small animal, but the amount of urine produced indicated that this organ was not fully distended. There appeared to be a lack of tone in the urethra and urine was allowed to escape. Sensation in the urethra could not have been entirely lost, as reflex raising of the tail and humping of the back were normal. However, O. H. Brooks (unpublished report, 1951—Queensland Department of Agriculture and Stock Files) has observed that, in field cases which he autopsied, the bladder was fully distended.

Symptoms first appeared in one of the experimental heifers several days after the feeding of grasstree was stopped and were most advanced three weeks afterwards. In the other they were evident after 30 days, and death occurred nine days later. The plant toxin, therefore, had a delayed

effect on the experimental animals. This might suggest a nutritional deficiency such as has been demonstrated in bracken poisoning (Evans, Evans and Roberts 1951); or perhaps the toxin produces direct nerve damage. However, the damage to nerve tissue cannot be extensive or recovery would not be a notable character of the disease.

VI. ACKNOWLEDGEMENTS.

Thanks are due to several officers of the Department of Agriculture and Stock who assisted with this work, especially to Mr. L. White and Mr. T. W. Murray, Inspectors of Stock, who supplied most of the plant used in the feeding experiments. The work of the Biochemical Section of the Queensland Department of Agriculture and Stock in carrying out the analyses reported is appreciated.

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STUDIES OF THE COCCOIDEA. 4. NEW SPECIES OF ASPIDIOTINI.

By A. R. BRIMBLECOMBE, M.Sc., Senior Entomologist, Division of Plant Industry.

SUMMARY.

New species described in the Aspidiotini are Pseudotargionia cordata, P. marginata, P. crenulata, Duplaspidiotus spinosus, D. carptellus, Pseudaonidia dimidiata, P. dentata **and** Rhizaspidiotus cassiniae.

Pseudotargionia cordata n.sp.

(Figs. 1 and 2.)

Locality and host.—Queensland; Carbrook, on *Melaleuca nodosa* Sm., May 1954.

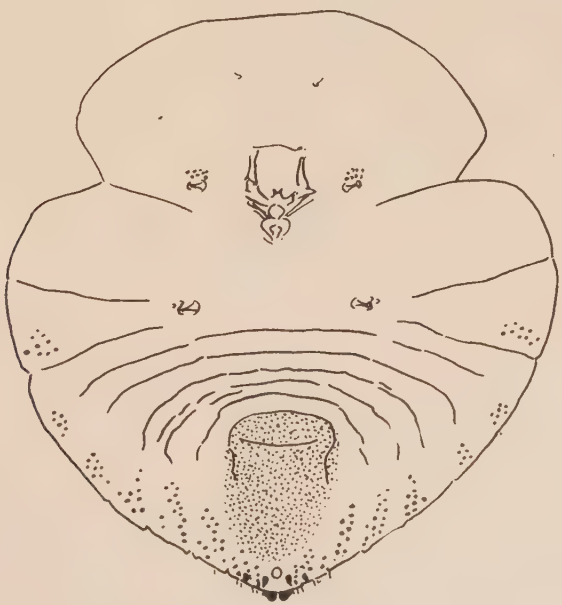

Fig. 1.

Pseudotargionia cordata. Outline of body. (x 70).

Habit.—Insects single and sparse, under the cork tissue in surface depressions of twigs. Scale and overlying cork tissue thin; under-surface of scale whitish.

Recognition characters.—Adult female with a deep thoracic constriction, anterior portion dome-shaped, posterior portion wider, cordate. Length of slide specimen 1·0 mm., width 0·9 mm. Pygidium not differentiated, apex broadly rounded. Median pair of lobes only, united basally but with a dorsal anal groove, length and width subequal, widest basally, apex broadly rounded, inner margins almost parallel with a subapical indentation, outer margins

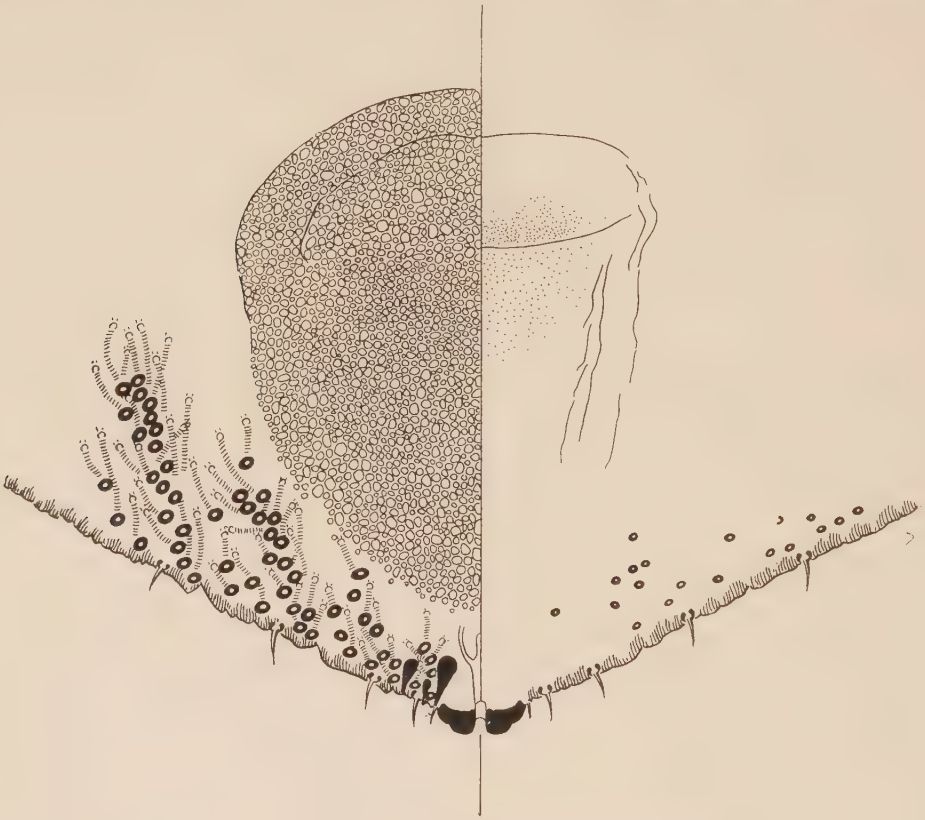

Fig. 2.

Pseudotargionia cordata. Enlargement of pygidium. (x 210).

convergent to each other, slightly irregular. Basal scleroses absent. Paraphyses in the first and second interlobal areas unevenly paired or apparently on the median side only in the first interlobal area, longer than median lobes and apically enlarged, smaller in the second interlobal area. Plates absent. Spines adjacent to the lobes shorter than the lobes, other spines longer. Dorsal ducts short and slender; orifices small with chitinized rims, in segmental series, four in the first duct furrow, seven in the second, 16 in the third and 20 in the fourth, a fifth series present and other anterior ducts submarginal on abdominal segments. Perivulvar pores absent. Anal opening small, slightly more than a lobe's length from the bases of the lobes. Margin of abdominal segments finely crenulate. Pygidium dorsally with a large median

area of finely reticulated chitinization, remainder of body with a fine finger-print chitinization. Anterior spiracles with 8-11 associated pores, posterior spiracles with 2 pores. Prothorax laterally with a cone-like protuberance.

Notes.—The heavy chitinization at maturity obscures the duct orifices. Thoracic protuberances may not be evident on old specimens. The species has features similar to *P. marginata* but has many more dorsal pygidial ducts and these are in segmental series.

Type slide Reg. No. T.5517 and paratypes Reg. Nos. T.5518 to T.5520 in the Queensland Museum.

Pseudotargionia marginata n.sp.

(Figs. 3 and 4.)

Locality and host.—Queensland; Ayr, on *Melaleuca viridiflora* Soland. ex. Gaertn., Feb. 1953 (W. A. Smith). Paratypes from the same and from Bowen on *Melaleuca viridiflora,* Apr. 1955 (G. W. Saunders).

Habit.—Insects single and sparse, on twigs, beneath cork tissue, undersurface of scale greyish white.

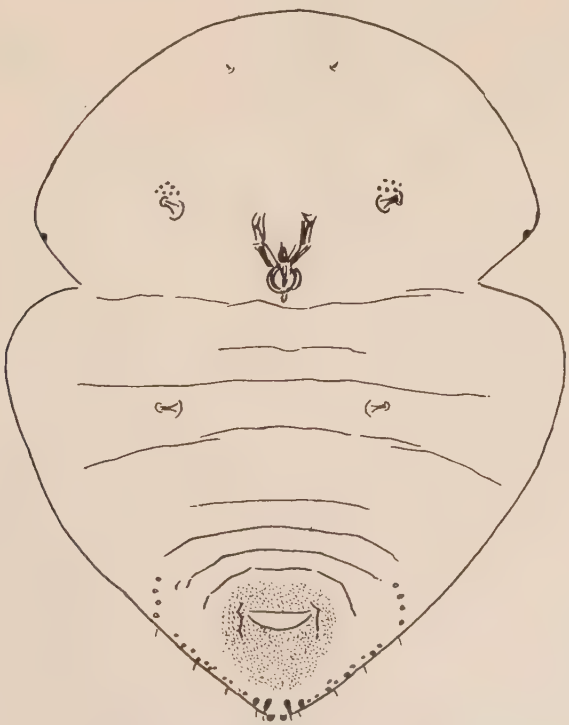

Fig. 3.

Pseudotargionia marginata. Outline of body. (x 70).

Recognition characters.—Adult female with a deep thoracic constriction, anterior portion dome-shaped, posterior portion wider, triangular. Length of slide specimen 1·3 mm., width 1·0 mm. Pygidium not differentiated, apex broadly rounded. Median pair of lobes only, as wide as long, united basally but with a dorsal anal groove, inner margins slightly curved, outer margins broadly curved, apices rounded with a subapical lateral indentation and a small indentation near the base. Basal scleroses absent. Paraphyses in the first interlobal area as long as the lobes; small

Fig. 4.

Pseudotargionia marginata. Enlargement of pygidium. (x 260).

in the second interlobal area. Spines at the bases of the median lobes half the lobe's length, other spines longer. Plates absent. Dorsal ducts submarginal, segmental series not evident, short, slender; orifices marginal. Perivulvar pores absent. Anal openings small in an inverted V, a lobe's length or less from the bases of the lobes. Pygidial margin crenulate. Median dorsal pygidial surface with finely reticulate chitinization. Body otherwise with a finger-print chitinization. Anterior spiracles with 5–11 associated pores.

Notes.—Lobes sometimes are triangular. Paraphyses in the first interlobal area may be club-like. The body at maturity is heavily chitinized, with dorsal pygidial margin slightly overlying the ventral, obscuring the

paraphyses in the second interlobal area and the duct orifices. A minute protuberance or a corresponding small differentiated area is evident posterior to the prothoracic extremities.

Young adult females are subcircular, the anterior dome-shaped portion being comparatively small, but enlarging with growth.

The species resembles *P. cordata* but differs from it in that the posterior portion of the body is distinctly triangular and the dorsal pygidial ducts are marginal and less in number.

Type slide Reg. No. T.5509 and paratype Reg. Nos. T.5510 to T.5512 in the Queensland Museum.

Pseudotargionia crenulata n.sp.

(Figs. 5 and 6.)

Locality and host.—Queensland; Ormiston, on *Melaleuca leucadendra* (L.) L. (*sens. lat.*), Sept. 1950. Paratypes from the same and from Tugun on *M. leucadendra*, May 1953.

Habit.—Insects single and sparse on twigs under thin layer of cork tissue or in bark depressions. Under-surface of scale whitish. First pellicle yellow.

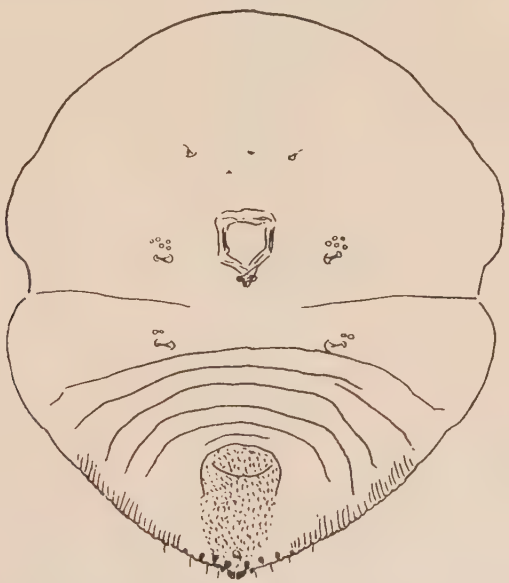

Fig. 5.

Pseudotargionia crenulata. Outline of body. (x 70).

Recognition characters.—Adult female with a thoracic constriction, anterior portion dome-shaped, posterior portion wider, semicircular. Length of slide specimen 0.9 mm., width 0.75 mm. Pygidium not differentiated, apex

obtuse, broadly rounded. Median lobes convergent, longer than wide, united basally with a dorsal anal groove, inner margins sub-parallel or slightly concave, outer margins broadly curved to a subapical indentation, apices rounded. Second pair of lobes small, tooth-like, triangular. Paraphyses as uneven pairs in the first and second interlobal areas, larger on the inner side, subequal in length to the median lobes. Plates absent. Spines adjacent to the median lobes short and inconspicuous, other spines longer than the median lobes. Dorsal ducts short, slender; orifices small, in segmental series but numbers obscured by heavy chitinization. Perivulvar pores absent. Anal opening small, in an inverted V, a lobe's length from the bases of the lobes.

Fig. 6.

Pseudotargionia crenulata. Enlargement of pygidium. (x 230).

Body margin crenulate to the thoracic constriction. Median dorsal pygidial area with irregular reticulate chitinization. Body elsewhere with heavy finger-print chitinization. Anterior spiracles with 5 or 6 associated pores, posterior spiracles with 2 or 3 pores.

Notes.—Young adult females are subcircular and the anterior portion comparatively small. In older specimens the anterior and posterior portions are almost equal in size.

The species differs from *P. cordata* and *P. marginata* in that it has a pronounced marginal crenulation of the body extending anteriorly to the thoracic constriction and the median lobes are more uniform in width, apically convergent, with the inner margins tending to be concave.

Type slide Reg. No. T.5505 and paratype Reg. Nos. T.5506 to T.5508 in the Queensland Museum.

Duplaspidiotus spinosus n.sp.

(Figs. 7 and 8.)

Locality and host.—Queensland; Chinchilla, on *Geijera parviflora* Lindl., Apr. 1953 (J. Mann).

Habit.—Insects single and sparse on twigs. Scale of female 1.5 mm. diameter, mostly greyish white, slightly darkening near centre. Second pellicle black with a thin pale greyish suffusion. First pellicle yellowish brown. Old specimens grey over most of the scale surface.

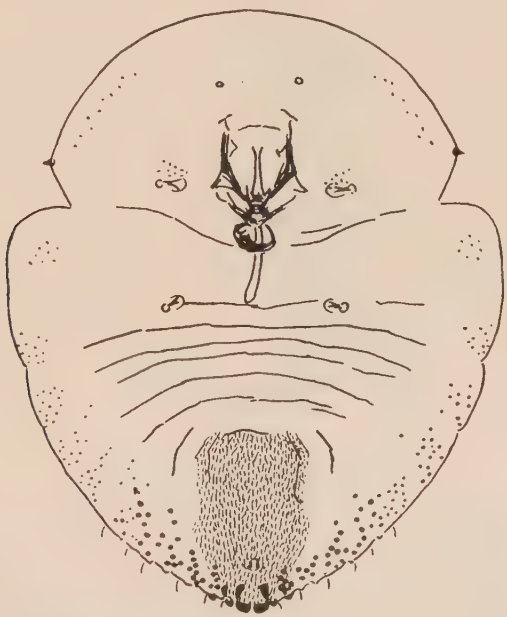

Fig. 7.

Duplaspidiotus spinosus. Outline of body. (x 70).

Recognition characters.—Adult female with a deep thoracic constriction, anterior portion dome-shaped with a stout lateral spine, posterior portion wider, triangular. Length of slide specimen 1.2 mm., width 1.0 mm. Pygidium not differentiated, apex broadly rounded. Three pairs of lobes. Median lobes wider than long, united basally, barely separated apically, apex broadly curved from the lateral margin. Second pair of lobes of similar shape but much

smaller, separated from the median lobes by a third to half of the second lobe's width. Third pair of lobes small, broad, chitinous and dome-shaped or truncated, separated from the second lobes by the width of the median lobes. Large chitinous triangular lobe-like points on each of the fifth, fourth and third abdominal segments, with a few intervening tooth-like projections. Basal scleroses absent. Paraphyses on the inner side of the first, second, and third interlobal areas; the first and second subequal in length to the median lobes, apparently clubbed; the third shorter. Plates slender, apices bifid, as long as or slightly longer than the second lobes, two in each of the first and second interlobal spaces. Spines small adjacent to the median lobes, other spines longer than the lobes. Dorsal ducts small, medianly slightly exceeding the distance to the anal opening; orifices small, three in the first duct furrow,

Fig. 8.

Duplaspidiotus spinosus. Enlargement of pygidium. (x 210).

about eight in the second, others in segmental series but dispersed, present on all body segments to the thoracic constriction and some evident in a submarginal row anterior to the constriction. Anal opening small, two to three times the median lobe's length from the bases of the median lobes. Median pygidial area with reticulate chitinization, remainder of body with a heavy finger-print chitinization. Anterior spiracles with 5 to 7 associated pores.

Notes.—The plates in some specimens appear to be simple. The tooth-like projections on the pygidal and abdominal margins may appear like lobes, and the heavy body chitinization obscures the duct orifices.

The species differs from *D. carptellus* in having a stout lateral spine on each side of the prothorax, and pores associated with the anterior spiracles.

Type slide Reg. No. T.5524 and paratypes Reg. Nos. T.5525 to T.5526 in the Queensland Museum.

Duplaspidiotus carptellus n.sp.

(Figs. 9 and 10.)

Locality and host.—Victoria; Mallee, on *Acacia* sp., 1918 (J. E. Dixon).

Habit.—Insects sparse on leaves. Scales circular, outer part white, gradually darkening to fawn towards the centre. Second pellicle black but with a whitish suffusion. First pellicle pale yellow-brown.

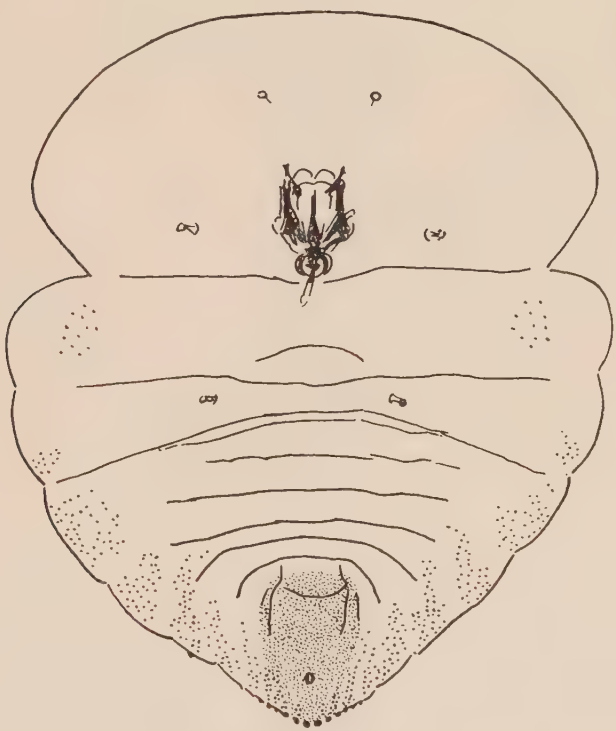

Fig. 9.

Duplaspidiotus carptellus. Outline of body. (x 70).

Recognition characters.—Adult female with a deep thoracic constriction, anterior portion sub-oval to dome-shaped, posterior portion wider, triangular. Length of slide specimen 1·2 mm., width 1·1 mm. Pygidium not differentiated, apex broadly rounded. Three pairs of lobes. Median lobes wider than long, ventrally united basally, separated by a line's width apically, narrower basally, outer apical surfaces broadly curved to rounded apices. Second lobes similar in shape but much smaller, half the width of the median lobes and separated from these by twice a median lobe's width. Third lobes slightly

narrower and shorter than second, apex broadly rounded with irregular small indentations, separated from the second by its own width. Margin beyond the third lobe with irregular tooth-like chitinous projections, with other anterior smaller serrations. Basal scleroses absent. Paraphyses as slight chitinous thickenings on the inner side of the first, second, and third interlobal areas, a small thickening noticeable in the fourth area. Plates absent in the median interlobal space, two in the first interlobal space, slender, simple, as long as the lobes, two similar plates in the second interlobal space. Dorsal ducts in

Fig. 10.

Duplaspidiotus carptellus. Enlargement of pygidium. (x 210).

segmental series, medianly extending slightly beyond the anal opening, five or six in the first duct furrow, 14 to 17 in the second, about 20 in the third, scattered and numerous submarginally on other abdominal segments with a small submarginal cluster on the metathorax. Perivulvar pores absent. Anal opening small, four to five times the median lobe's length from the bases of the lobes. Median dorsal pygidial area with reticulate chitinization, body otherwise with heavy finger-print chitinization. Spiracular pores and lateral thoracic spines absent.

Notes.—Chitinization on young mature females only as a pear-shaped area medianly on the pygidium. The tooth-like projections beyond the third lobe are heavily chitinised and resemble lobes.

Type slide in the C.S.I.R.O. collection, Canberra. Paratype slide Reg. No. T.5528 in the Queensland Museum.

Pseudaonidia dimidiata n.sp.

(Figs. 11 and 12.)

Locality and host.—Queensland; Gayndah, on *Acacia harpophylla* F. Muell., ex. Benth., Aug. 1951.

Habit.—Insects single and sparse on leaves. Scales circular, up to 2·5 mm. diameter, white, second pellicle dark with a grey suffusion. First pellicle olive green.

Recognition characters.—Adult female with a deep thoracic constriction, anterior portion dome-shaped, posterior portion wider, sub-triangular. Length of slide specimen 1·2 mm., width 0·9 mm. Pygidium not differentiated, apex broadly rounded. Four pairs of lobes. Median lobes as wide as long, separated

Fig. 11.

Pseudaonidia dimidiata. Outline of body. (x 70).

by half a lobe's width, narrowed basally, a subapical indentation on each margin, apex broadly rounded. Second pair of lobes of similar shape but slightly smaller, with the outer apical margin slightly more curved, separated from the median lobes by half the width of the latter. Third lobes similar to the second but outer apical margin slightly more curved, separated from the second by the median lobe's width. Fourth lobes similar to the third but of half their width, separated from the third by twice the width of the third but with an intervening chitinized derm projection of similar size to the fourth lobe. All lobes with longitudinal striations. Pygidial margin anterior to the fourth lobes irregularly toothed, the larger projections indicating

segments. Basal scleroses absent. Paraphyses as small chitinous thickenings subequal to the length of the lobes, as a pair in the median interlobal area, and single on the inner side of the first, second, and third interlobal areas. Plates slender, bifid, as long as the lobes, two in the median and first interlobal spaces, three in the second and one on each side of the derm projection in the third. Spines adjacent to lobes shorter than the lobes. Dorsal ducts slender, medianly half as long as the distance between the lobes and anal

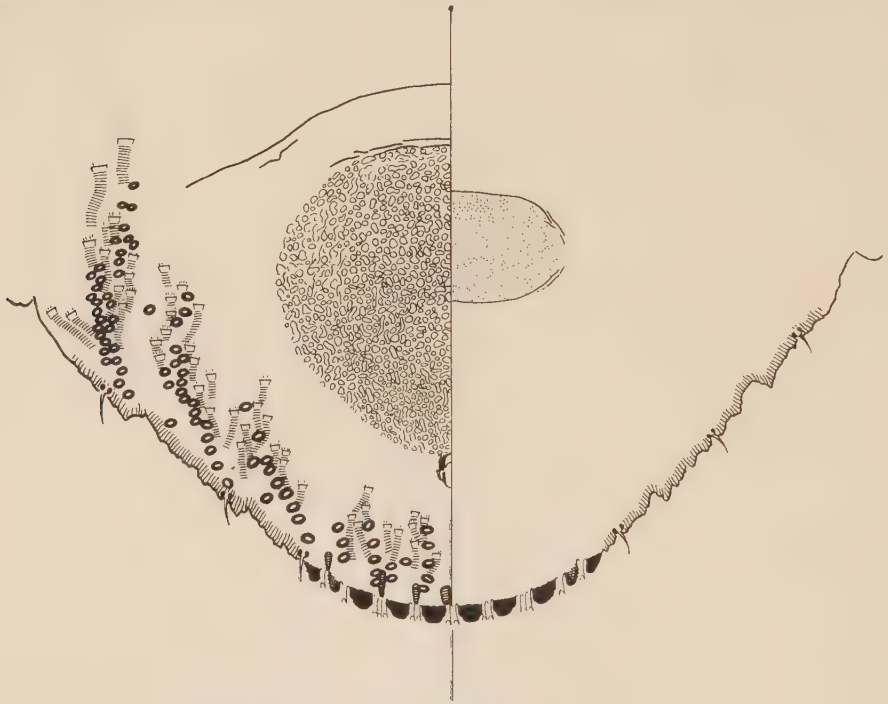

Fig. 12.

Pseudaonidia dimidiata. Enlargement of pygidium. (x 230).

opening; orifices in segmental series, six in the first duct furrow, nine in the second, four in an intervening row, about 18 in the third, with rows on each of the other abdominal segments. Perivulvar pores absent. Anal opening small, five times the median lobe's length from the bases of the lobes. Median pygidial area with irregular reticulate chitinization, the remainder of the body surface with a heavy finger-print chitinization. Anterior spiracles with 11 or 12 associated pores.

Notes.—The large process between the third and fourth lobes has a duct orifice and therefore is derm although resembling a lobe. The four normally shaped lobes, the lobe-like derm projection and the number of spiracular pores are characters separating the species from *P. dentata.*

Type slide Reg. No. T. 5521 and paratypes Reg. Nos. T. 5522 and 5523 in the Queensland Museum.

Pseudaonidia dentata n.sp.

(Figs. 13 and 14.)

Locality and host.—Queensland; Drillham, on *Acacia harpophylla* F. Muell. ex. Benth., Apr. 1953 (J. Mann).

Habit.—Insect on twig, scale circular, general colour brownish grey.

Recognition characters.—Adult female with a deep thoracic constriction, anterior portion oval, posterior portion wider, triangular. Length of slide specimen 1·3 mm., width 1·05 mm. Pygidium not differentiated, apex rounded. Three pairs of normal lobes. Median pair of lobes as wide as long with a subapical indentation on each margin, apex broadly rounded. Second pair of lobes slightly smaller than the median, width and length

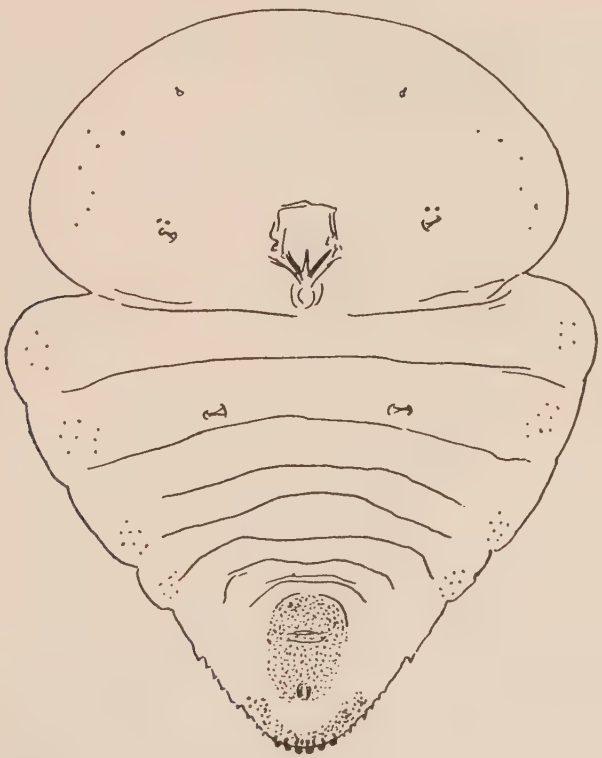

Fig. 13.

Pseudaonidia dentata. Outline of body. (x 70).

subequal, with only the outer subapical indentation, separated from the median by less than its own width. Third pair of lobes similar to the second but slightly smaller, with the outer apical margin slightly more curved, separated from the second by the width of the median lobes. All lobes with longitudinal striations. Pygidial margin beyond the third lobe irregularly toothed, a

large tooth marking each segment with intervening slightly smaller teeth. Basal scleroses absent. Paraphyses small chitinous thickenings, as a pair approximately the length of the lobes in the median area, and singly on the inner side of the first, second, and third interlobal areas. Plates slender, as long as the lobes, two in each of the median and first interlobal spaces, mostly bifid, three in the second space, similar to those in the first, three in the third space, middle one on a small dermal projection apparently bifid. Spines associated with the lobes shorter than the lobes, others longer. Dorsal

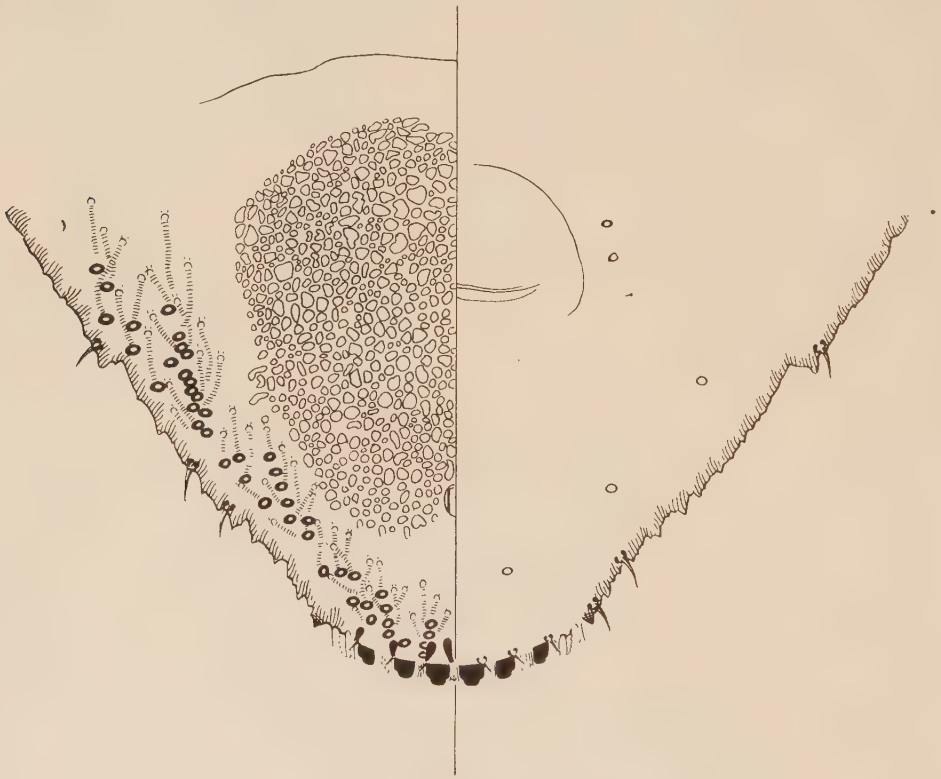

Fig. 14.

Pseudaonidia dentata. Enlargement of pygidium. (x 240).

ducts slender, four orifices in the first duct furrow, seven in the second, others in segmental series with a few intervening. Perivulvar pores absent. Anal opening small, five to six times the median lobe's length from the bases of the lobes. The median dorsal pygidial area with a chitinous reticulation, remainder of body with a heavy finger-print chitinization. Anterior spiracles with two or three associated pores.

Notes.—Only three pairs of uniformly shaped lobes are present; the fourth is represented by a tooth-like structure which resembles other marginal tooth-like structures. The derm process in the third interlobal area is surmounted by a plate.

The number of marginal tooth-like structures is greater in this species than in *P. dimidiata*. The dorsal ducts are less numerous and only two pores are associated with the anterior spiracles.

Type slide Reg. No. T.5527 in the Queensland Museum.

Rhizaspidiotus cassiniae n.sp.

(Figs. 15 and 16.)

Locality and host.—Queensland; Inglewood, on *Cassinia laevis* R.Br., Feb. 1954. Paratypes from the same and from Gore on *Cassinia* sp. ("Rosemary"), Aug. 1935.

Habit.—Insects under pieces of loose bark on twigs. Colour of scales dirty grey but this may have been due to extensive sooty mould from other insects.

Recognition characters.—Adult female subcircular to broadly pyriform; length of slide specimen 0·9 mm., width 0·8 mm. Pygidium broadly rounded. Median pair of lobes only, as broad as long, separated by less than a quarter of

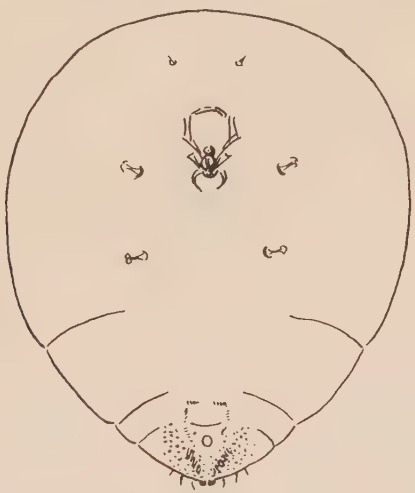

Fig. 15.

Rhizaspidiotus cassiniae. Outline of body. (x 70).

a lobe's width, widest apically, inner margins concave, outer margins almost parallel to each other, apices broadly truncated and margins slightly concave, inner latero-apical angle slightly acute but rounded. Basal scleroses as long as but narrower than the lobes. Paraphyses absent. Two slender pointed plates in the median interlobal space, shorter than the lobes. Two broad plates in the first interlobal space, shorter than the lobes. Plates in the second interlobal space absent. Spines twice as long as the lobes. Dorsal ducts short, in segmental series with apparently intersegmental series; 12 in the first duct furrow, about 20 in the second, and more numerous in the third, other

series anteriorly. Anal opening large, five times its length from the bases of the lobes. Paravulvar folds long, slender, and curved. A pair of dorsal prevulvar scars present. Pygidial margin crenulate.

Notes.—Differentiation of the duct orifices into furrow series and interfurrow series is difficult, particularly in the more anterior series. The interfurrow series between the first and second furrows may extend slightly anterior to the anal opening. The ducts are about twice as long as the anal opening and the orifices are comparatively large. The paravulvar folds may

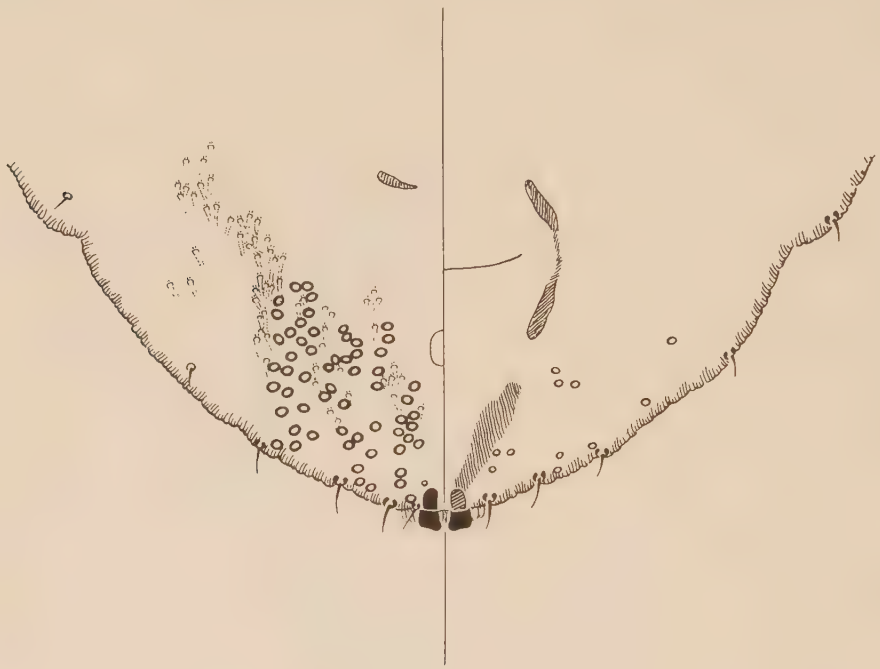

Fig. 16.

Rhizaspidiotus cassiniae. Enlargement of pygidium. (x 230).

be halved. Sometimes two pairs of prevulvar scars are present. The plates in the first interlobal space do not appear to be branched, possibly because of the mounting. A small domed marginal cephalic prominence is evident in some instances. The absence of plates in the second interlobal space, the numerous duct orifices and the large spines separate this species from *R. chenopodii* (Marlatt.).

Type slide Reg. No. T.5513 and paratypes Reg. Nos. T.5514 to T.5516 in the Queensland Museum.

ACKNOWLEDGEMENTS.

Thanks are due to Dr. A. J. Nicholson, Chief, Division of Entomology, C.S.I.R.O., for material of *Duplaspidiotus carptellus*.

Mr. W. W. Manley, Departmental Illustrator, made the drawings for all the figures.

STUDIES OF PLANT AND SOIL NEMATODES. 1. TWO NEW SPECIES FROM QUEENSLAND.

By R. C. COLBRAN, M.Agr.Sc., Entomologist, Division of Plant Industry.

SUMMARY.

Two new nematodes, Hemicycliophora truncata **and** Trichodorus minor, **are described.**

A number of new nematode species closely related to known plant parasites have been found in Queensland in the course of a survey, and two are described in this paper.

Hemicycliophora truncata n.sp.

(Fig. 1.)

Female. L = 0·6–0·8 mm.; a = 21–22, b = 4·3–4·5, c = 55–60; V = $^{50}98$.

Males absent; females numerous.

Body arcuate when killed by gentle heat and surrounded by a loose larval cuticle attached closely to the body at the head and anus and reflexed behind the tail. Larval cuticle coarsely striated except over the head and tail. Lateral field present. Lip region rounded, with the labial disc only slightly elevated above the head contour. Head offset, rounded on the anterior margins, and with a prominent posterior annule. Body cylindrical, and constricted posterior to the vulva. Tail conical, and bluntly rounded in adults; more pointed in larvae.

Spear dorsally arcuate, 84–103μ long, with well developed basal knobs practically flat at the base. Oesophagus with a well developed precorpus about five-ninths as wide as the body; precorpus joined by a narrow isthmus, crossed by a nerve ring, to the small corpus about one-third as wide as the body. Excretory pore opening on the ventral surface adjacent to the middle region of the terminal oesophageal bulb. Intestine vacuolated, with coarse colourless granules and opening via the anus situated immediately posterior to the vulva. Vagina deep, parallel to body axis. Gonad single, prodelphic, outstretched, narrow. Spermatheca absent.

Type locality.—Archerfield (Brisbane).

Diagnosis.—H. truncata is distinguished by the presence of the loose cuticle reflexed behind the tail, and the posterior position of the vulva.

Occurrence.—H. truncata was collected about the roots of *Chloris gayana* Kunth (Rhodes grass) established in test blocks in a wallum area at Archerfield.

Type slide Reg. No. G.2309 and unmounted type material Reg. No. G.2310 are in the Queensland Museum.

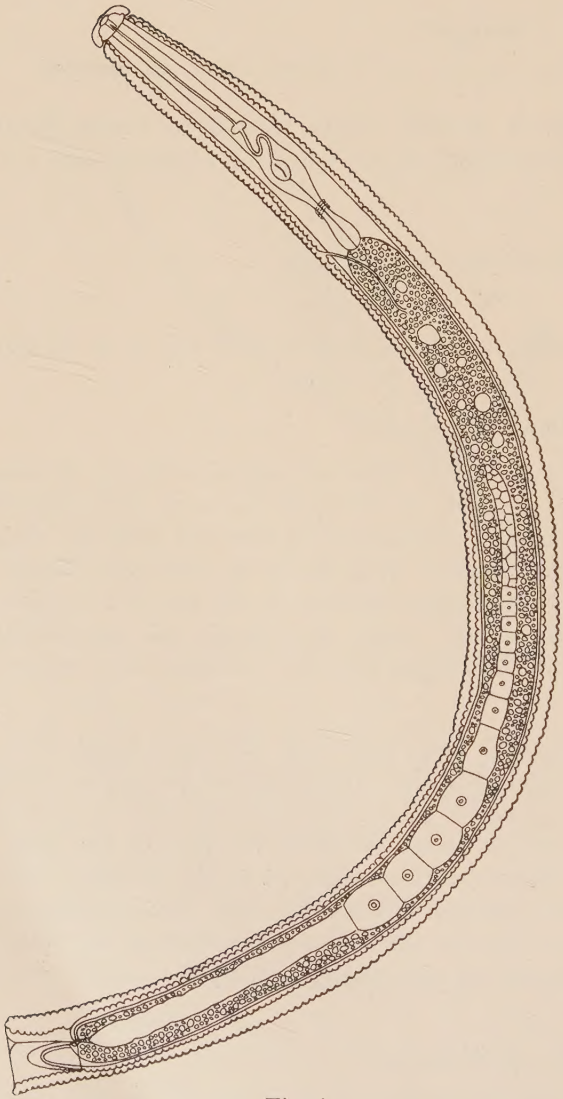

Fig. 1.

Hemicycliophora truncata n.sp. Adult female. (x 270).

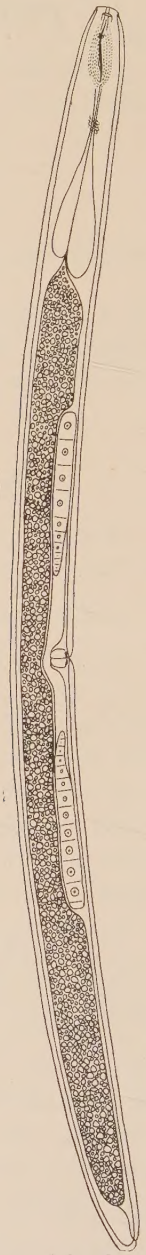

Fig. 2.

Trichodorus minor n.sp.
Adult female. (x 270).

Trichodorus minor n.sp.

(Fig. 2.)

Female. L = 0·55–0·70 mm.; a = 19–25, b = 5·2–6·0; V = $^{20-25}52–55^{20-25}$

The several thousand specimens examined were all females.

Body straight when killed by gentle heat, most mounted specimens lying on the dorsal rather than the lateral surfaces. Head and tail not distorted when fixed in F.A. 10, a characteristic of *T. pachydermus* Seinhorst (Seinhorst 1954).

Body stout, tapering both anteriorly and posteriorly. Head and tail bluntly rounded. Outer cuticle not striated but fine striae visible on the subcuticle. Distance between cuticle and subcuticle variable in both living and mounted specimens, often exceeding 5μ without deformations of the body. Vestibule tubular, semicuticularized. Spear linear, 29–34μ long, dorsally arcuate and tripartite in the middle section, surrounded by an elongate bundle of muscle fibres. Amphids obscure in many specimens but appear characteristic of the genus. Guiding ring present behind vestibule.

Anterior half of the oesophagus narrow and crossed by a nerve ring, expanding to a more or less cylindrical bulb about five-sixths as wide as the body. Terminal portion of bulb slightly lobed, the oesophago-intestinal junction situated at the base of the lobes. Largest lobe ventrally placed. Intestine filled with coarse colourless granules which obscure details of the internal anatomy. Rectum 14–16μ long, close to the ventral surface of the body in its posterior two-thirds. Anus almost terminal. Vulva practically equatorial, the opening surrounded by a circular area, 9–11μ in diameter, not staining deeply in cotton blue lactophenol. Vagina extends about one-third across the body. Gonads paired, opposed and reflexed about two-thirds way back to the vulva.

Type locality.—Moggill.

Diagnosis.—Distinguished from *T. primitivus* (de Man) Micol. and *T. pachydermus* by its smaller size, presence of oesophageal lobes, and the absence of males.

Occurrence.—*T. minor* is widespread in Queensland, and has been found in association with the following plants:—*Lycopersicon esculentum* Mill. (tomato), Stanthorpe; *Sesbania aculeata* Poir., Coolum; *Persea americana* Mill. (avocado), Ormiston; *Medicago sativa* L. (lucerne), Moggill; *Prunus persica* L. Batsch (peach), Pinkenba; *Citrus* sp., Brisbane; *Saccharum officinarum* L. (sugar cane), Bli Bli.

Type Slide Reg. No. G.2311 and unmounted type material Reg. No. G.2312 are in the Queensland Museum.

T. minor was reported as an undescribed species in previous papers by the author (Colbran 1954, 1955).

ACKNOWLEDGEMENTS.

Mr. W. W. Manley, Departmental Illustrator, prepared the drawings for the figures.

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